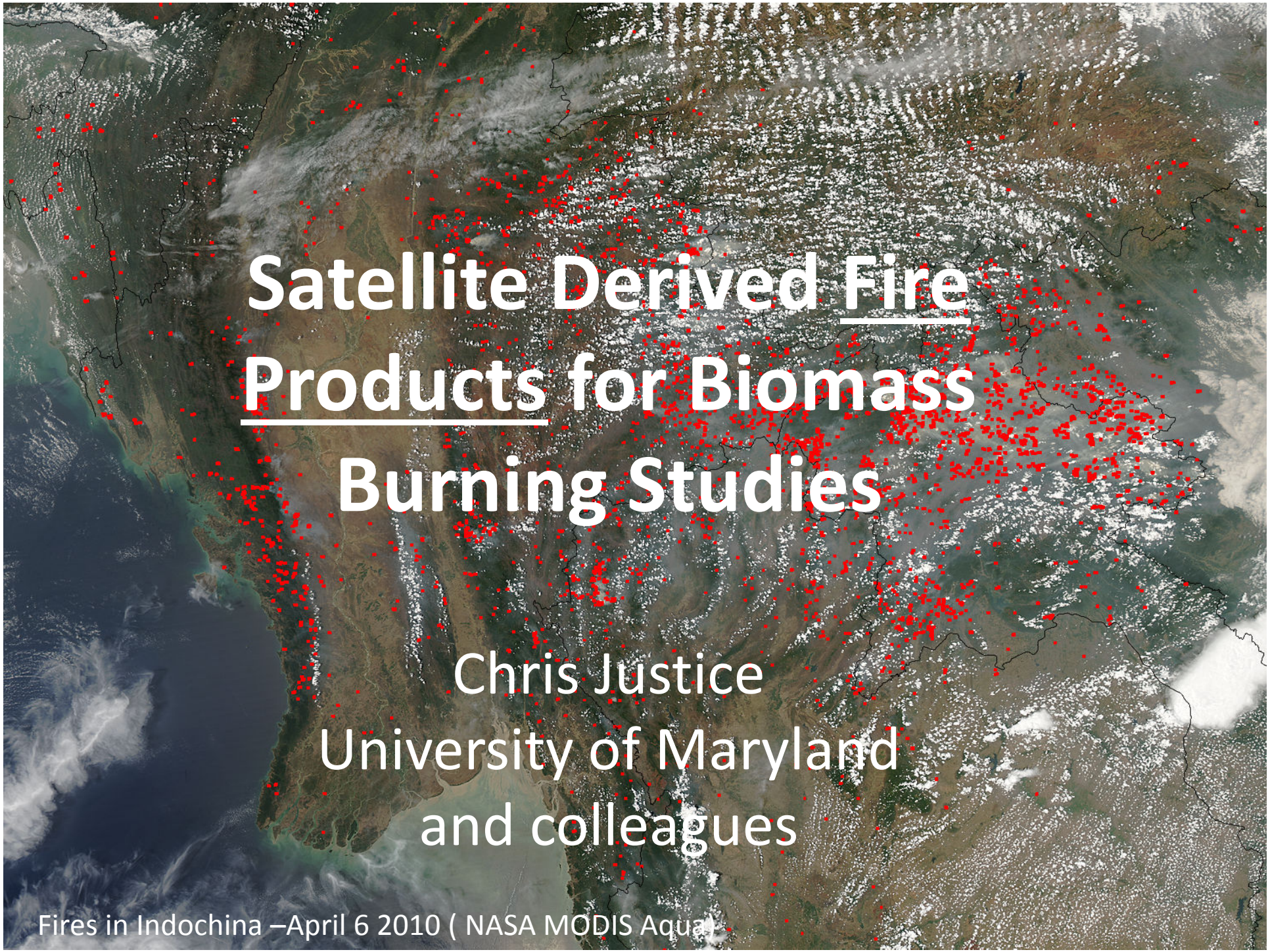


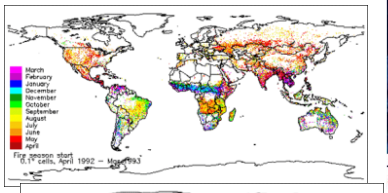
Satellite Derived Fire Products for Biomass Burning Studies

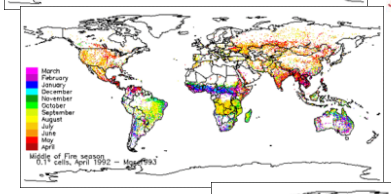
Chris Justice
University of Maryland
and colleagues

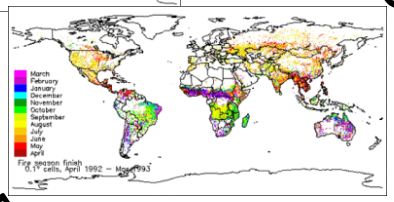
Fires in Indochina –April 6 2010 (NASA MODIS Aqua)

An Operational US Perspective

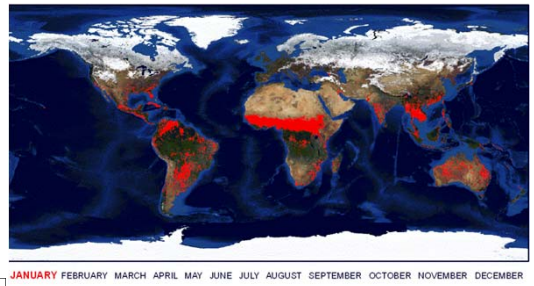
THE GLOBAL FIRE PRODUCT (1992-93)







bioval.jrc.ec.europa.eu/



1980s

1990s

2000s

2010s

AVHRR production

AVHRR global analyses

GOES production

GOFC-GOLD Fire

GCOS Fire ECV

MODIS production

MODIS validation

MODIS CMG

GOES reprocessing

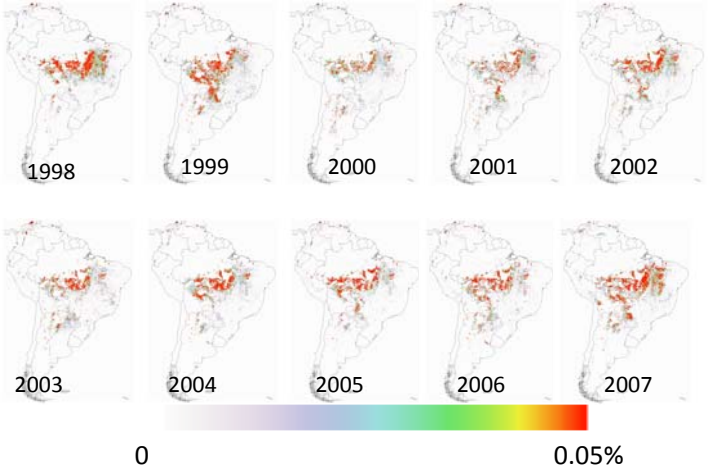
SNPP VIIRS

JPSS VIIRS

GOES-R ABI

PRESENT

Fraction of GOES clear-sky observations with fire



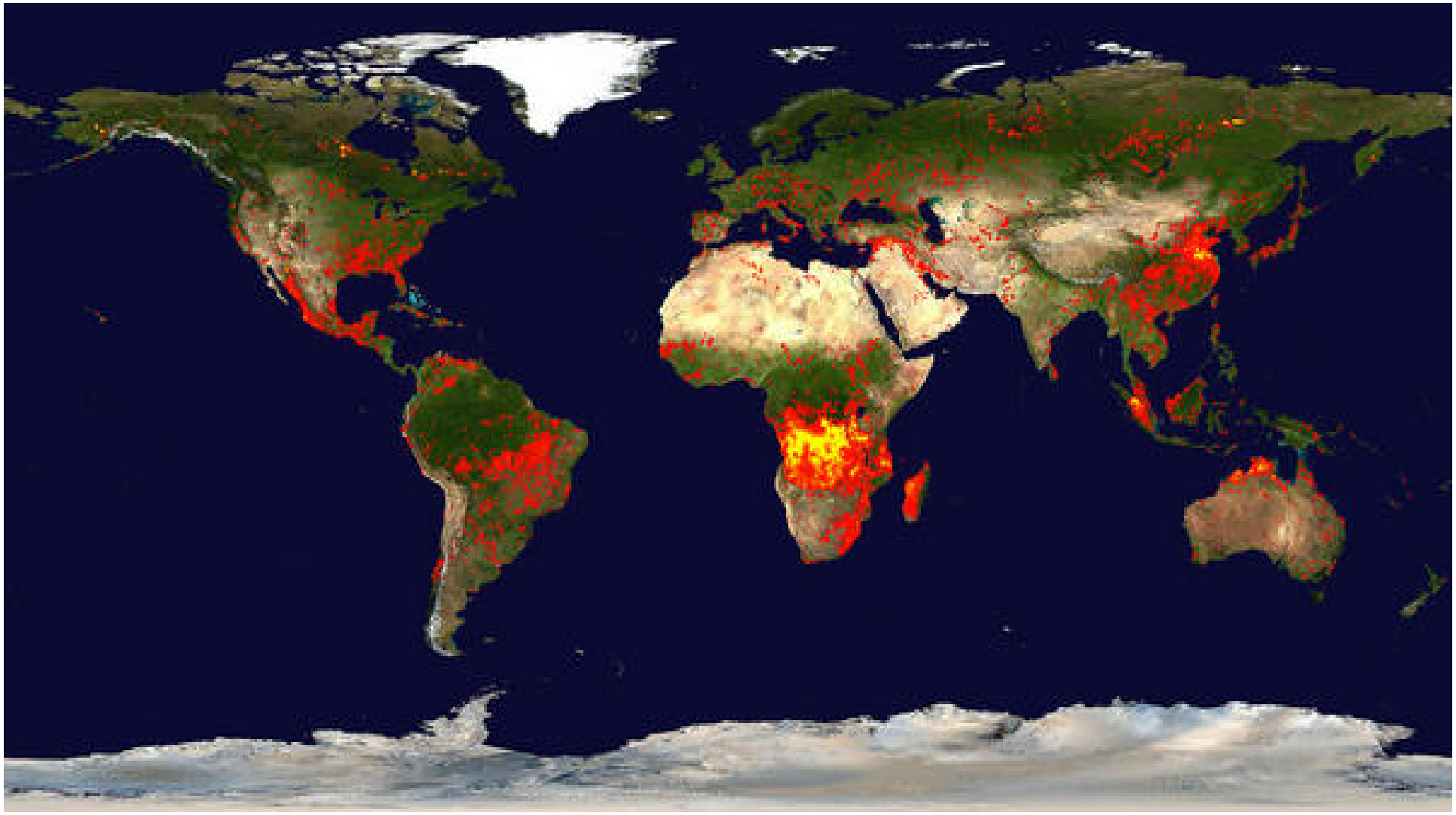
MODIS Active Fire detection product

hot-spot at time of Terra and Aqua overpass (MOD14/MYD14)

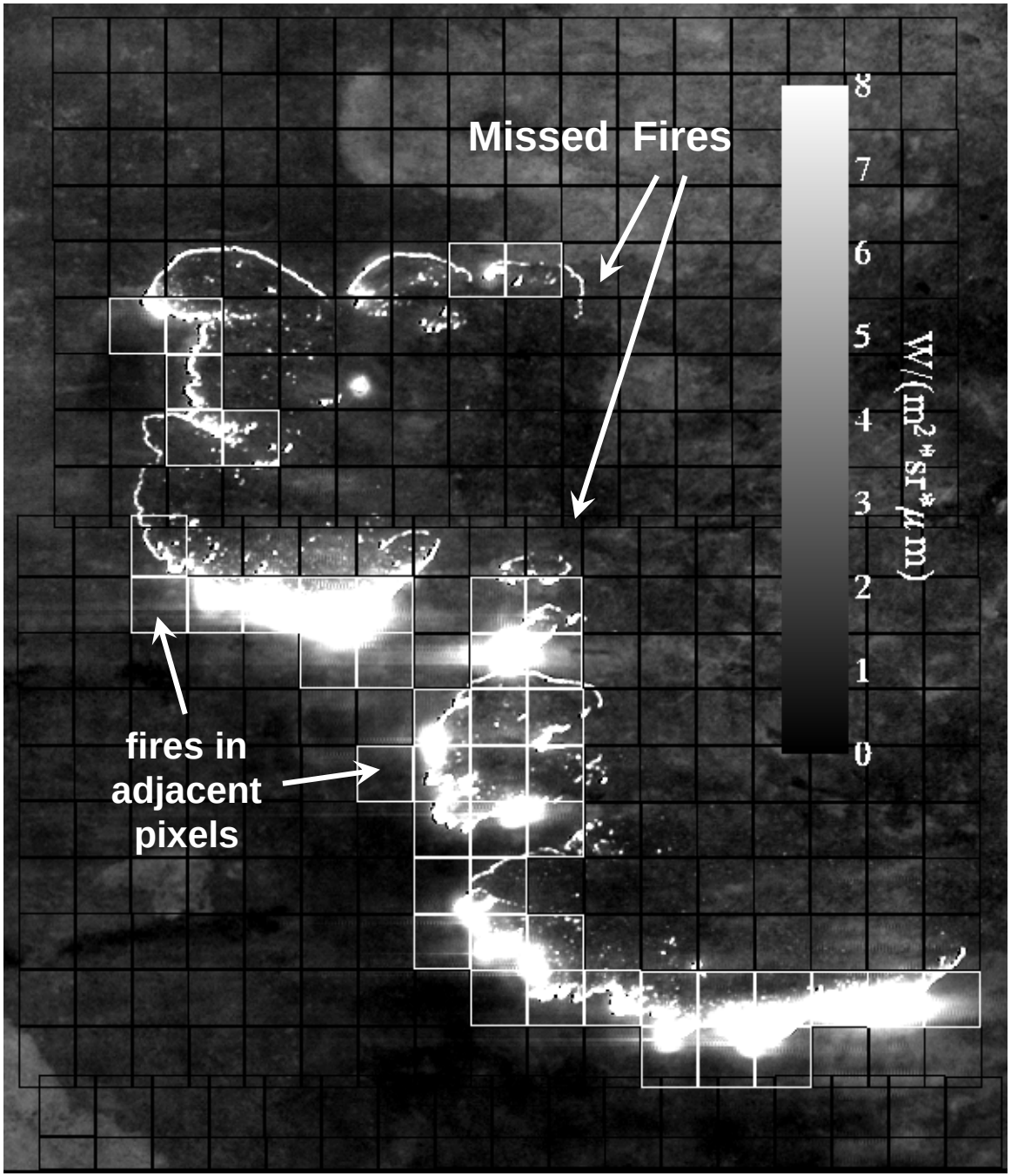
- Daily 1km, 8 day 1km, 0.25 deg. monthly
- Location and time of active fire detection
- Fire Radiative Power [Units: W]
- Generated for Collections 1, 3, 4, 5, 6

Satellite Detection of Fires Burning Last 10 days

MODIS Active Fire Detections 6/10 – 6/19 2013



Compiled Daily Observations taken by the NASA MODIS Satellite



MODIS Active Fire Product Validation

by comparison with contemporaneous ASTER data

ASTER image

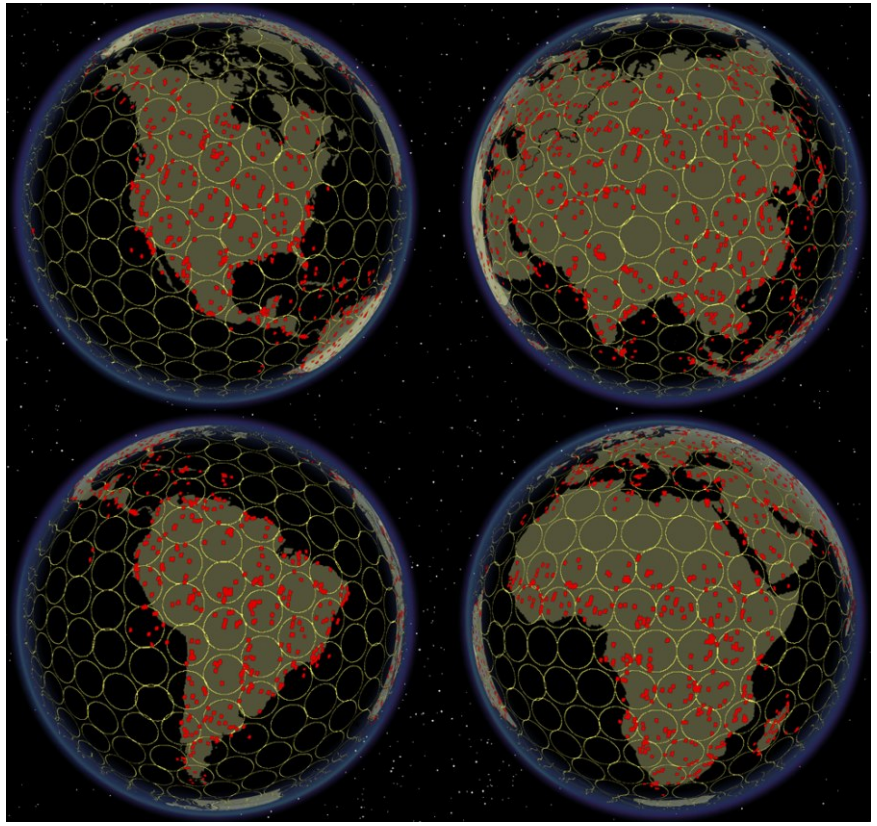
MODIS 1km observations (squares)

White squares: MODIS observations flagged as "fire" by MOD14

I. Csiszar

Global Validation of MODIS Active Fire Product

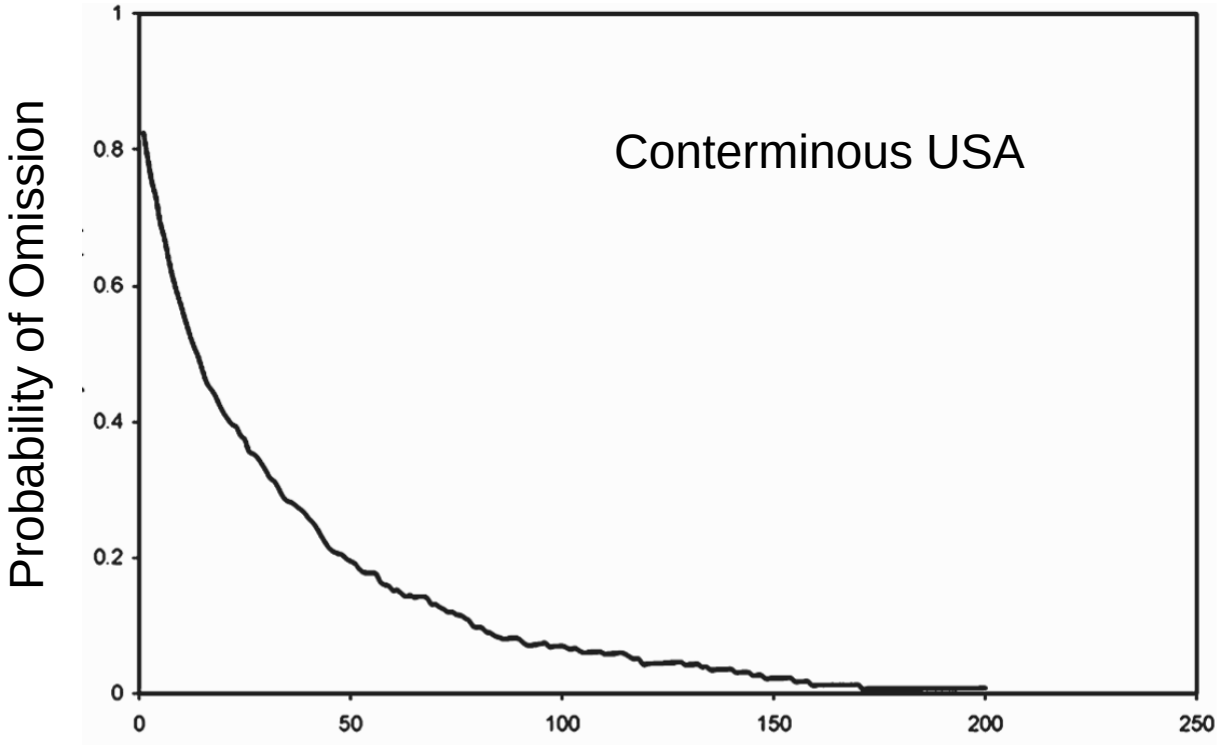
- 2500 ASTER scenes from 2001-2006
- Builds on earlier regional studies by Morisette et al. (2005), Csiszar et al. (2006), and Schroeder et al. (2008a,b)



CEOS LPV Stage 3 Validation "*product accuracy has been assessed and the uncertainties in the product well established via independent measurements in a systematic and statistically robust way*"

Schroeder et al.

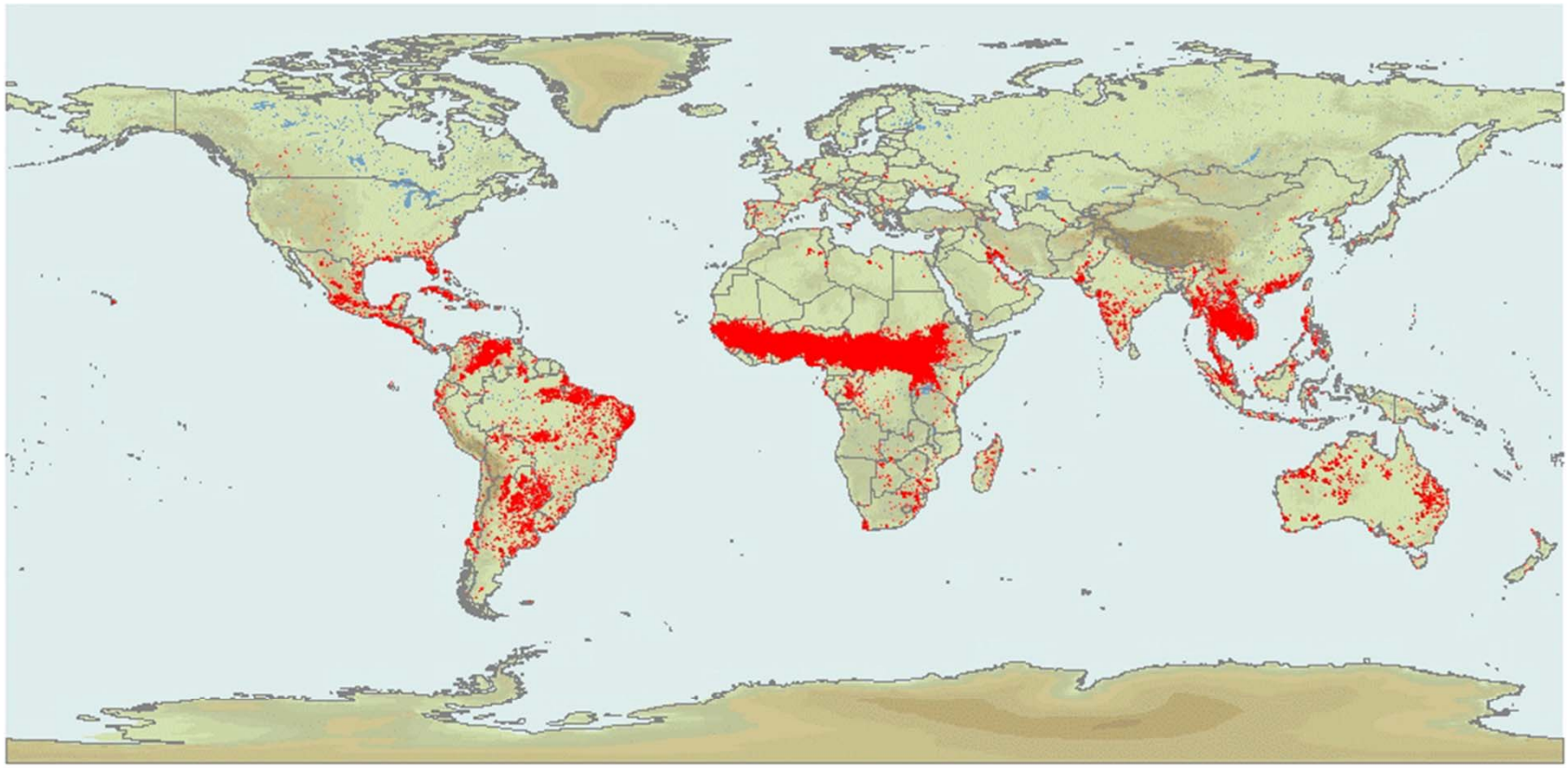
Example MOD14 Validation Results for Conterminous USA



Schroeder et al., 2008

Fire Seasonal Variability (2005)

MODIS Rapid Response Fire Detections for 2005

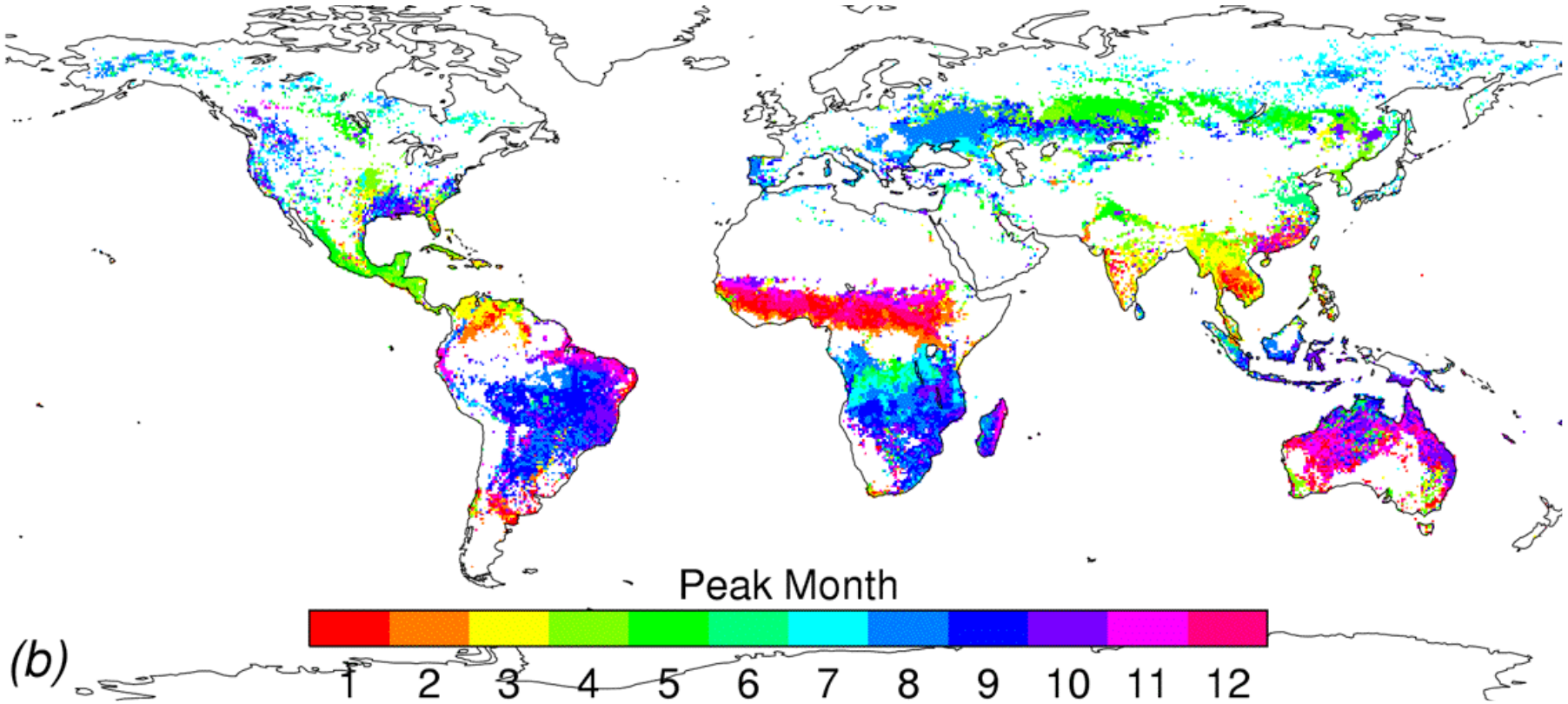


JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

MODIS Active Fire Detections
World Countries

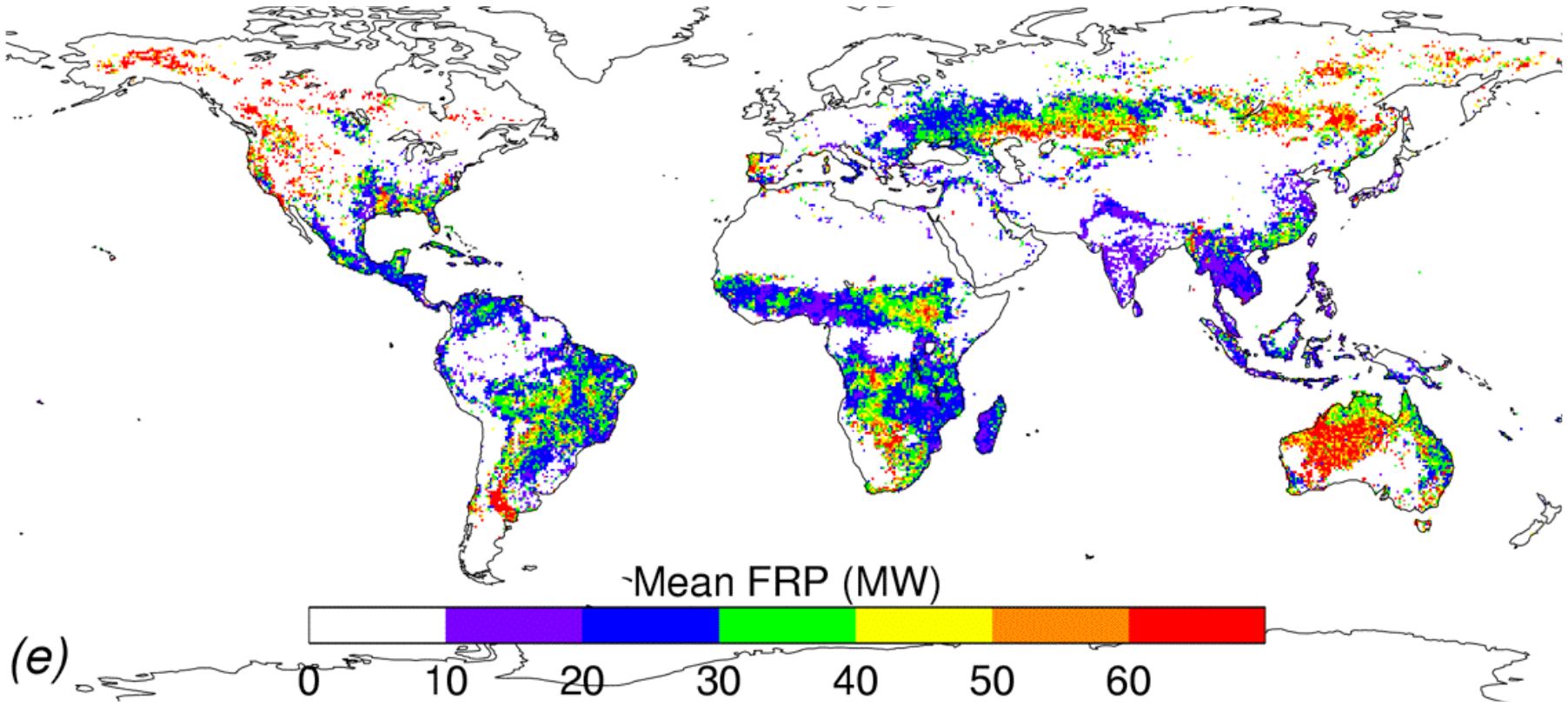
Active fires are detected using MODIS data from the Terra satellite.
Source: MODIS Rapid Response http://rapidfire.sci.gsfc.nasa.gov
Web Fire Mapper http://maps.geog.umd.edu

Global Fire Regime Characterization



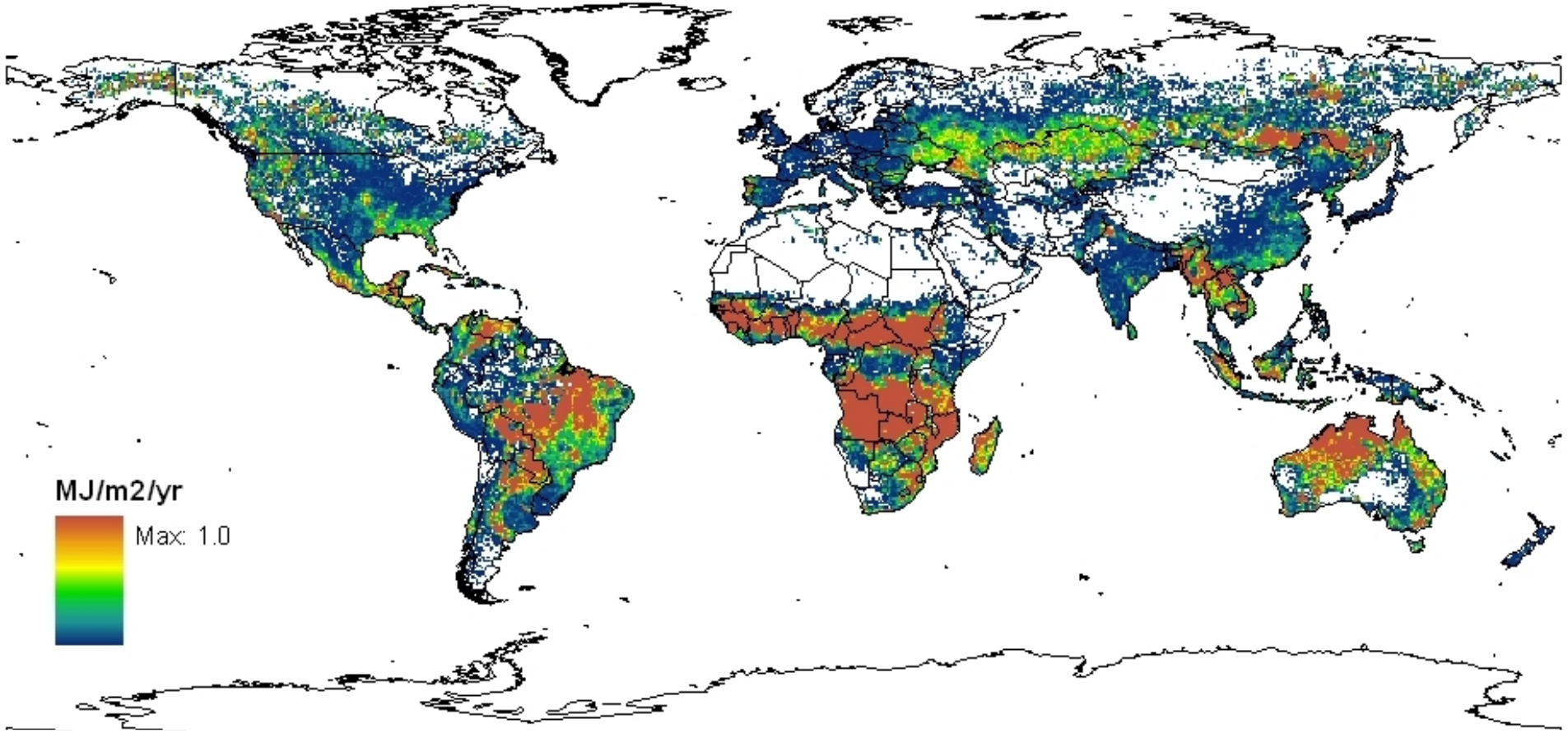
Peak Fire Month
(Terra MODIS; Nov. 2001 - Oct. 2005)

Global Characterization of active fire properties



Mean Fire Radiative Power
Radiant heat energy liberated per unit time
(Terra MODIS mean ; Nov. 2001 - Oct. 2005)

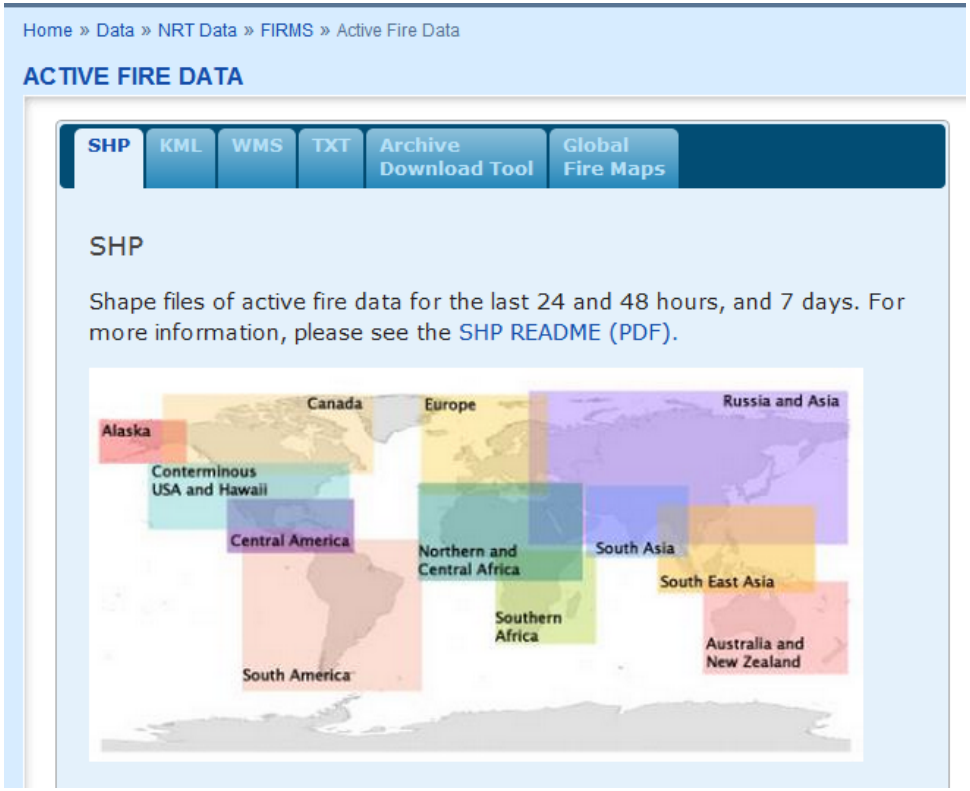
Estimated annual mean FRE ($MJ/m^2/yr$) MODIS Aqua 2001-2007



Diurnal cycle of hourly FRP was estimated in each climate modeling grid cell, and integrated over time (24 hours) and space (0.5°) to estimate FRE

(Evan Ellicot et al. 2009)

FIRMS - Fire Information for Resource Management



Based on end user requirements, FIRMS was developed by the University of Maryland using funds from NASA's Applied Sciences Program

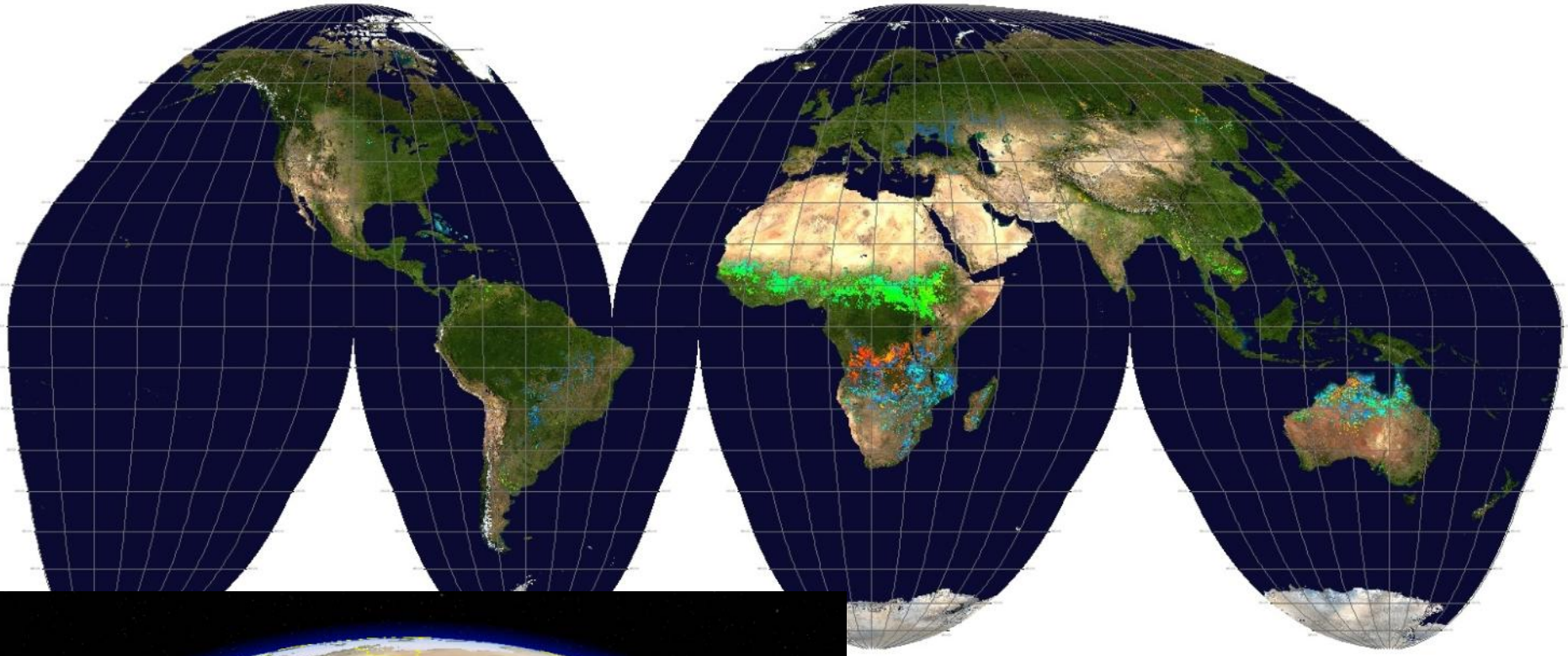
FIRMS delivers real-time fire data in a range of easy to use formats including NRT, daily and weekly email alerts

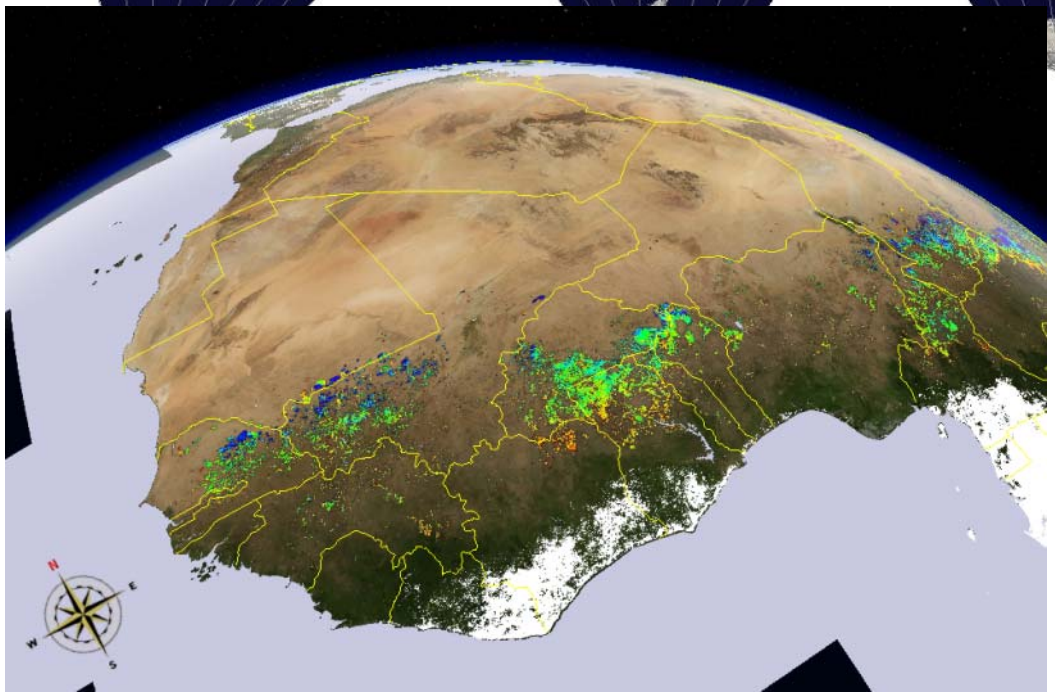
FIRMS has been made operational as the Global Fire Information Management System (GFIMS) at the United Nations FAO, Rome

FIRMS is now part of NASA's Earthdata website. For more information: **http://earthdata.nasa.gov/firms**

Burned Area product (MCD45)

- 500m Location and approximate day of burning
  - Day of burning stored as a monthly product
    - Generated for Collection 5.1





- Global Product 500m
- Monthly Composite – showing date of burning
- 2000 registered users for the bulk download FTP

Landsat data used for validation: Validation Protocol

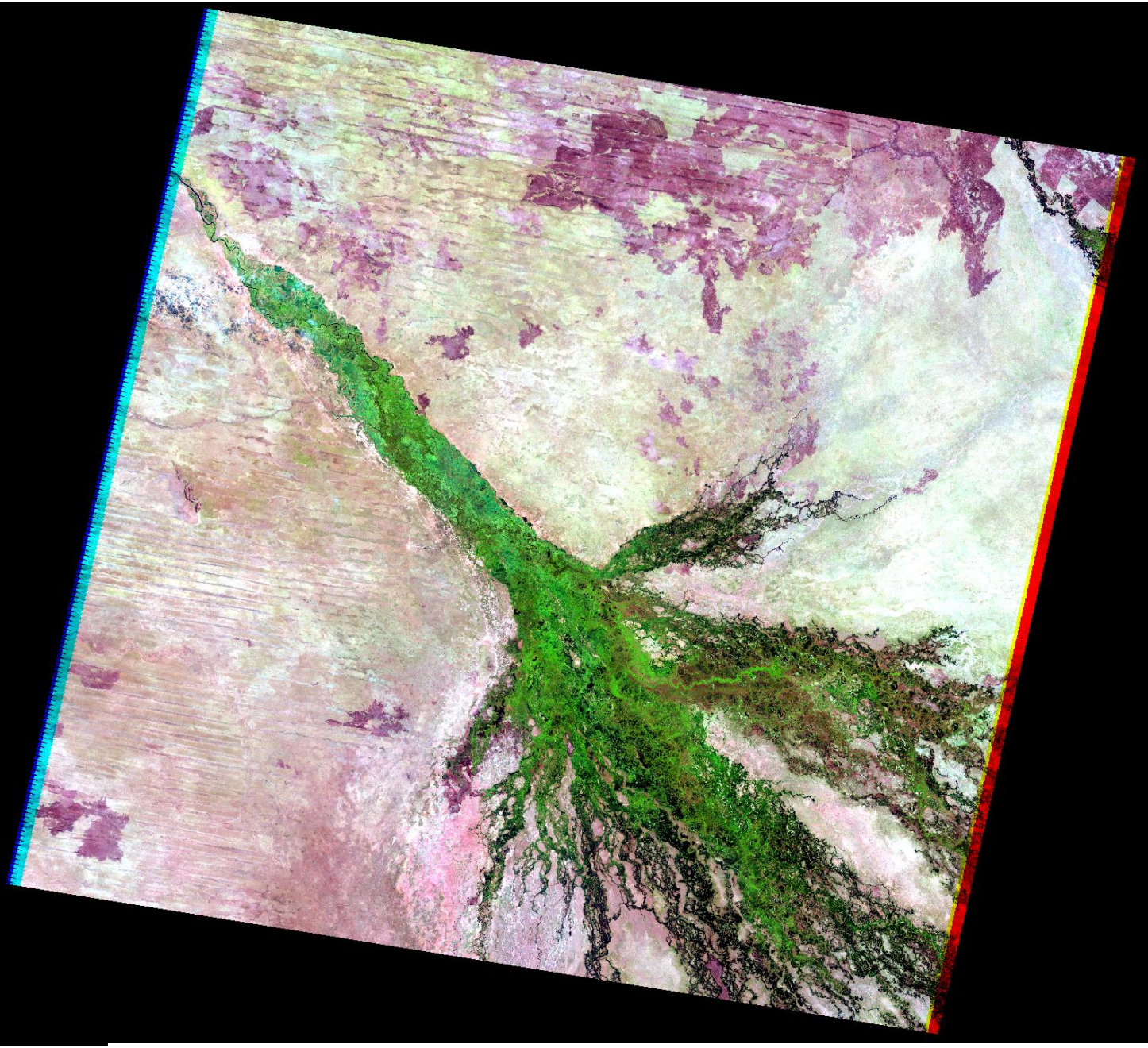
- Landsat-based validation protocol
  - Developed in SAFARI2000 with SAFNet
  - Expanded to other GOFC-GOLD regional networks
  - Protocol advocated & now adopted by the CEOS Cal/Val program, used by Fire CCI and MODIS MCD45

- Multi-temporal Landsat data
  - interpreted by regional experts
  - map the area burned between acquisitions
  - generate independent reference data set

Time 1:

Landsat ETM+

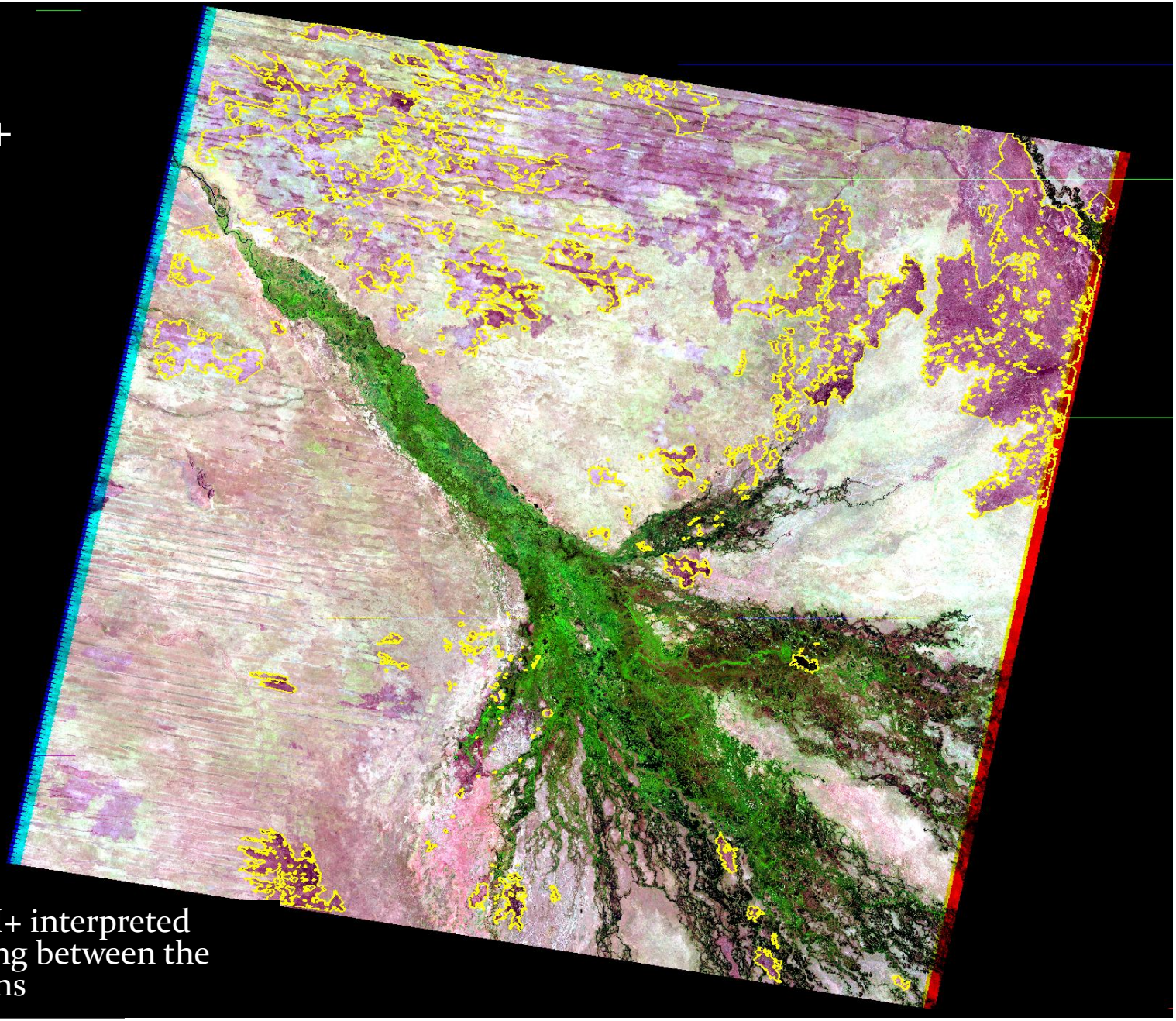
Sept. 4th



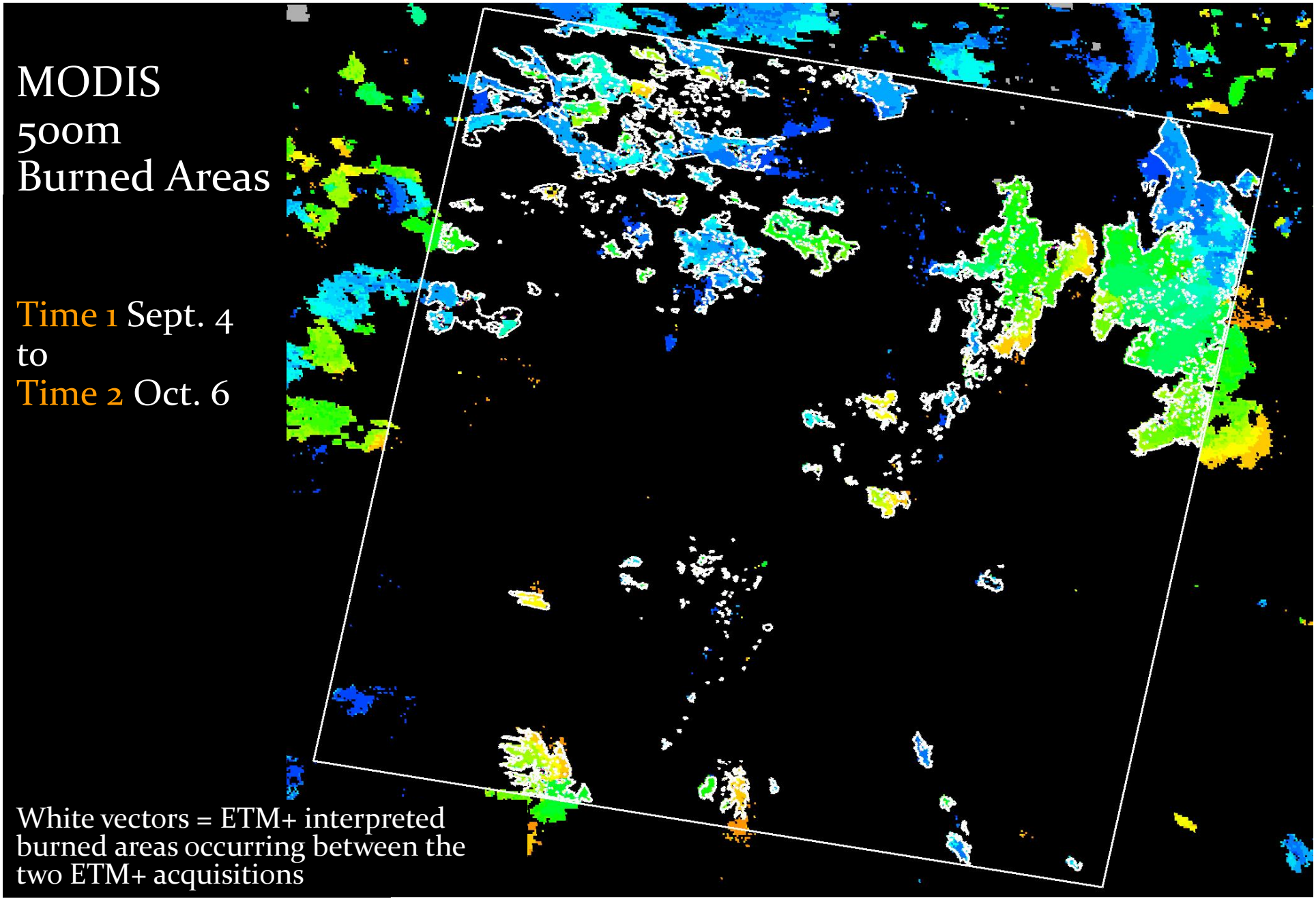
Time 2:

Landsat ETM+

Oct 6th

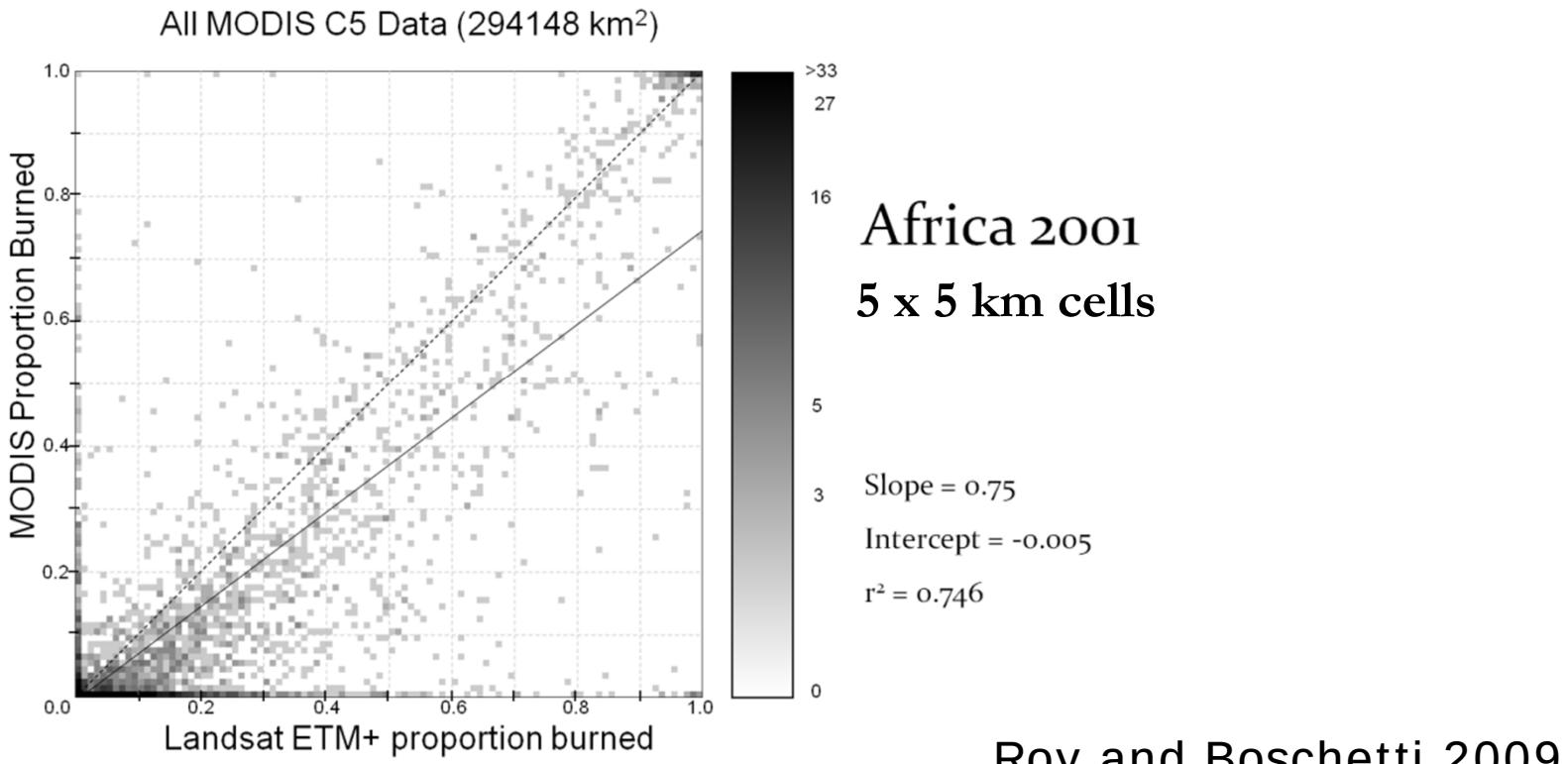


Yellow vectors = ETM+ interpreted burned areas occurring between the two ETM+ acquisitions


MODIS
500m
Burned Areas
Time 1 Sept. 4
to
Time 2 Oct. 6
White vectors = ETM+ interpreted burned areas occurring between the two ETM+ acquisitions

Validation Metrics

- Regression – regional spatial accuracy assessment



Roy and Boschetti 2009

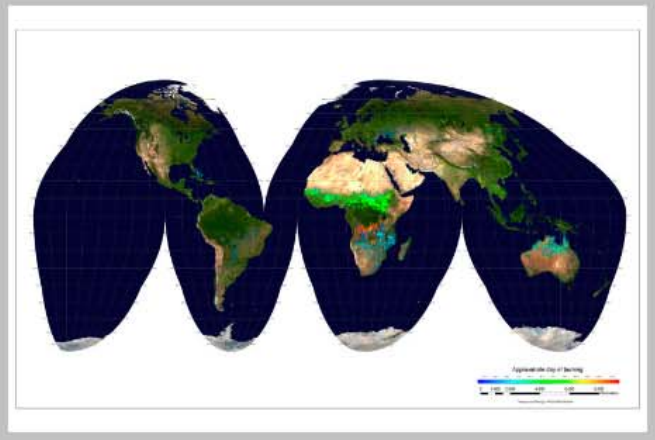
- Confusion matrix statistics (overall, user's & producer's accuracy) – pixel level accuracy assessment

MODIS Active Fire & Burned Area Products

Methodology
Validation
Description
Get Data
User Manual

Burned Area Products

Burned areas are characterized by deposits of charcoal and ash, removal of vegetation, and alteration of the vegetation structure (Pereira et al. 1997, Roy et al. 1999). The MODIS algorithm used to map burned areas takes advantage of these spectral, temporal, and structural changes (Roy et al. 2005a). It detects the approximate date of burning at 500 m by locating the occurrence of rapid changes in daily surface reflectance time series data. The algorithm maps the spatial extent of recent fires and not of fires that occurred in previous seasons or years.



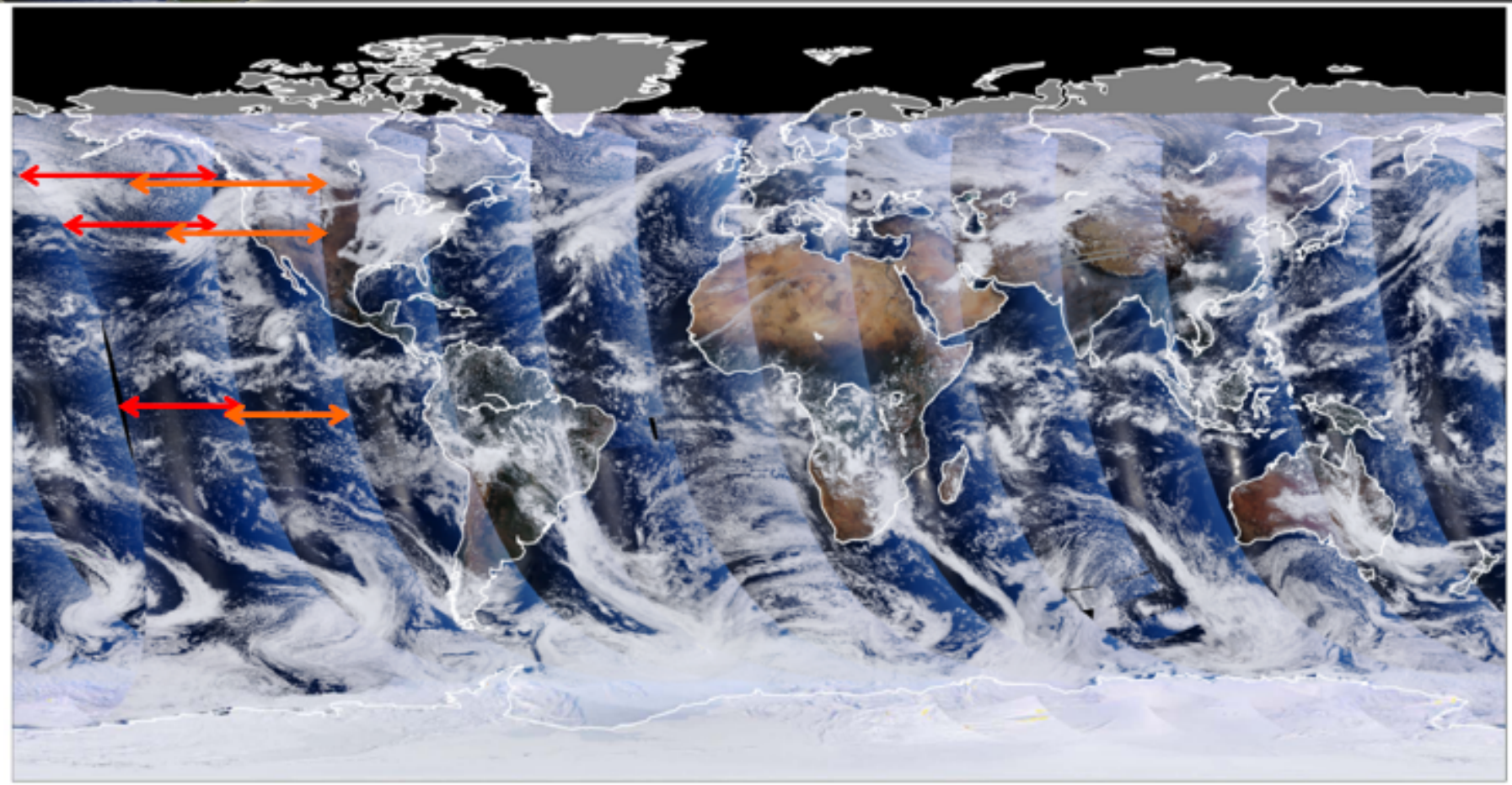
1 year of MCD45A1 burned areas; the day of burning is represented using a rainbow scale and is overlaid on MODIS surface reflectance to

News

World Wind 3D visualization
Burned Area GeoTIFFS available
Burned Area Product on WIST

Suomi NPP Launched Oct 28 2011

First Global VIIRS Image



VIIRS RGB (True Color), 20111122

R : M05 (0.672 μm); G : M04 (0.555 μm); B : M02 (0.445 μm)

VIIRS at a Glance

- VIIRS: Visible Infrared Imager Radiometer Suite
- VIIRS Heritage
  - OLS: Optical Line Scanner
  - AVHRR: Advanced Very High Resolution Radiometer
  - SeaWiFS: Sea viewing Wide Field-of-view Sensor
  - MODIS: Moderate Resolution Imaging Spectroradiometer
- VIIRS will provide operational and research users with:
  - Spectral coverage from 412 nm to 12 microns in 22 bands
    - Imagery at 375 m nadir resolution in 5 bands
    - Moderate resolution (750 m at nadir) radiometric quality data
  - Complete global daily coverage with a single sensor
- Near-real time data products
  - Cloud cover, cloud layers
  - Cloud and aerosol physical properties
  - Land & ocean biosphere properties, snow & ice
  - Sea Surface Temperature, Land & Ice Temperatures
  - **Fire detection**

B. Reed

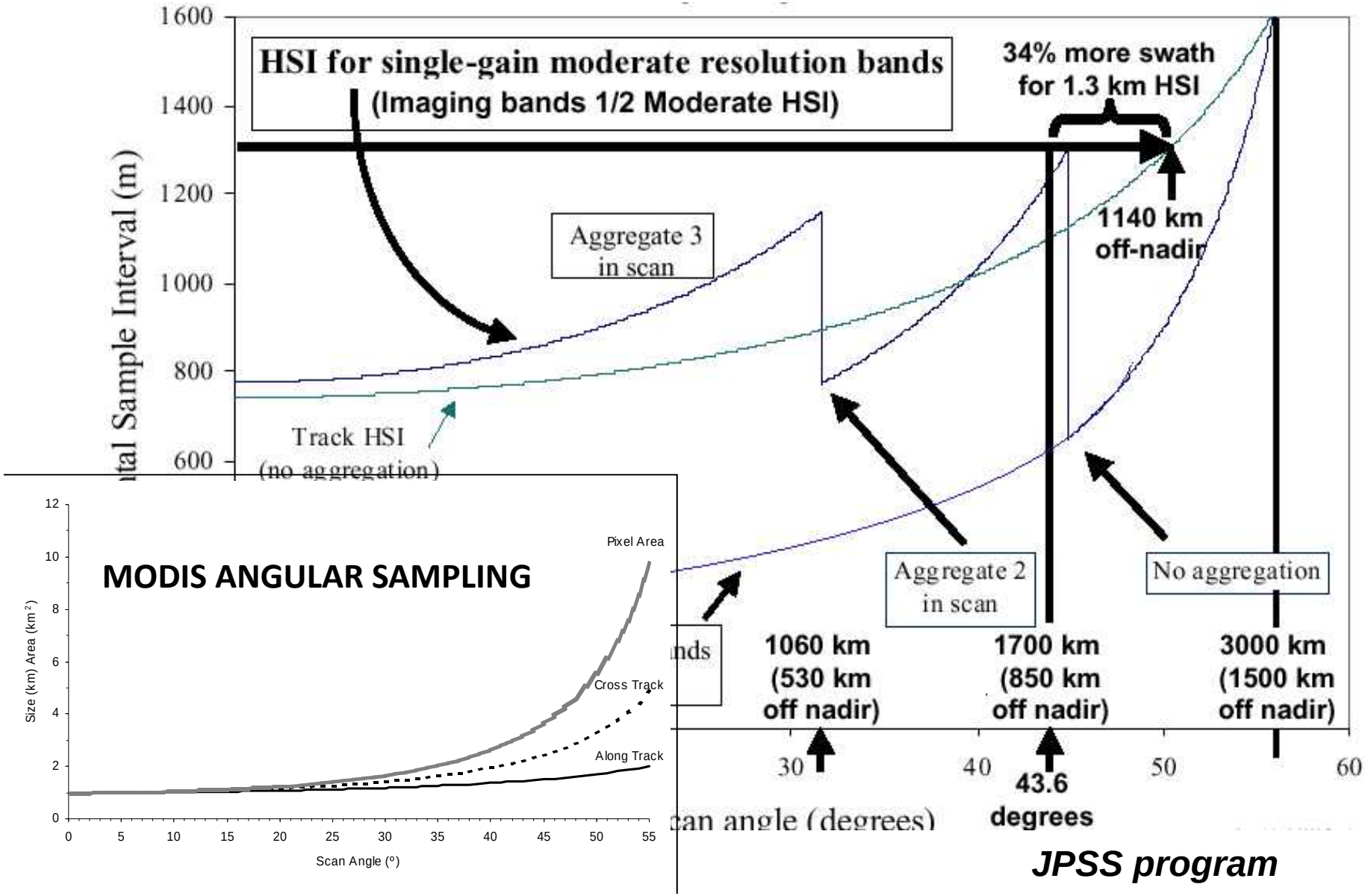
VIIRS Heritage: MODIS and AVHRR

VIIRS			MODIS Equivalent			AVHRR-3 Equivalent			OLS Equivalent		
Band	Range (um)	HSR (m)	Band	Range	HSR	Band	Range	HSR	Band	Range	HSR
DNB	0.500 - 0.900								HRD PMT	0.580 - 0.910 0.510 - 0.860	550 2700
M1	0.402 - 0.422	750	8	0.405 - 0.420	1000						
M2	0.436 - 0.454	750	9	0.438 - 0.448	1000						
M3	0.478 - 0.498	750	3 10	0.459 - 0.479 0.483 - 0.493	500 1000						
M4	0.545 - 0.565	750	4 12	0.545 - 0.565 0.546 - 0.556	500 1000						
I1	0.600 - 0.680	375	1	0.620 - 0.670	250	1	0.572 - 0.703	1100			
M5	0.662 - 0.682	750	13 14	0.662 - 0.672 0.673 - 0.683	1000 1000	1	0.572 - 0.703	1100			
M6	0.739 - 0.754	750	15	0.743 - 0.753	1000						
I2	0.846 - 0.885	375	2	0.841 - 0.876	250	2	0.720 - 1.000	1100			
M7	0.846 - 0.885	750	16	0.862 - 0.877	1000	2	0.720 - 1.000	1100			
M8	1.230 - 1.250	750	5	SAME	500						
M9	1.371 - 1.386	750	26	1.360 - 1.390	1000						
I3	1.580 - 1.640	375	6	1.628 - 1.652	500						
M10	1.580 - 1.640	750	6	1.628 - 1.652	500	3a	SAME	1100			
M11	2.225 - 2.275	750	7	2.105 - 2.155	500						
I4	3.550 - 3.930	375	20	3.660 - 3.840	1000	3b	SAME	1100			
M12	3.660 - 3.840	750	20	SAME	1000	3b	3.550 - 3.930	1100			
M13	3.973 - 4.128	750	21 22 23	3.929 - 3.989 3.929 - 3.989 4.020 - 4.080	1000 1000 1000						
M14	8.400 - 8.700	750	29	SAME	1000						
M15	10.263 - 11.263	750	31	10.780 - 11.280	1000	4	10.300 - 11.300	1100			
I5	10.500 - 12.400	375	31 32	10.780 - 11.280 11.770 - 12.270	1000 1000	4 5	10.300 - 11.300 11.500 - 12.500	1100 1100	HRD	10.300 - 12.900	550
M16	11.538 - 12.488	750	32	11.770 - 12.270	1000	5	11.500 - 12.500	1100			

VIIRS Fire Status: Sensor

- In some respects superior to MODIS
  - Spatial coverage
  - Spatial resolution
  - Radiometric calibration
  - ~~Crosstalk~~
- LWIR band (M15) saturation too low
- Primary fire band (M13) susceptible to more atmospheric absorption than heritage instruments
- On-board aggregation flawed
  - Saturated pixels not properly handled
- Idiosyncratic features due to unusual lineage

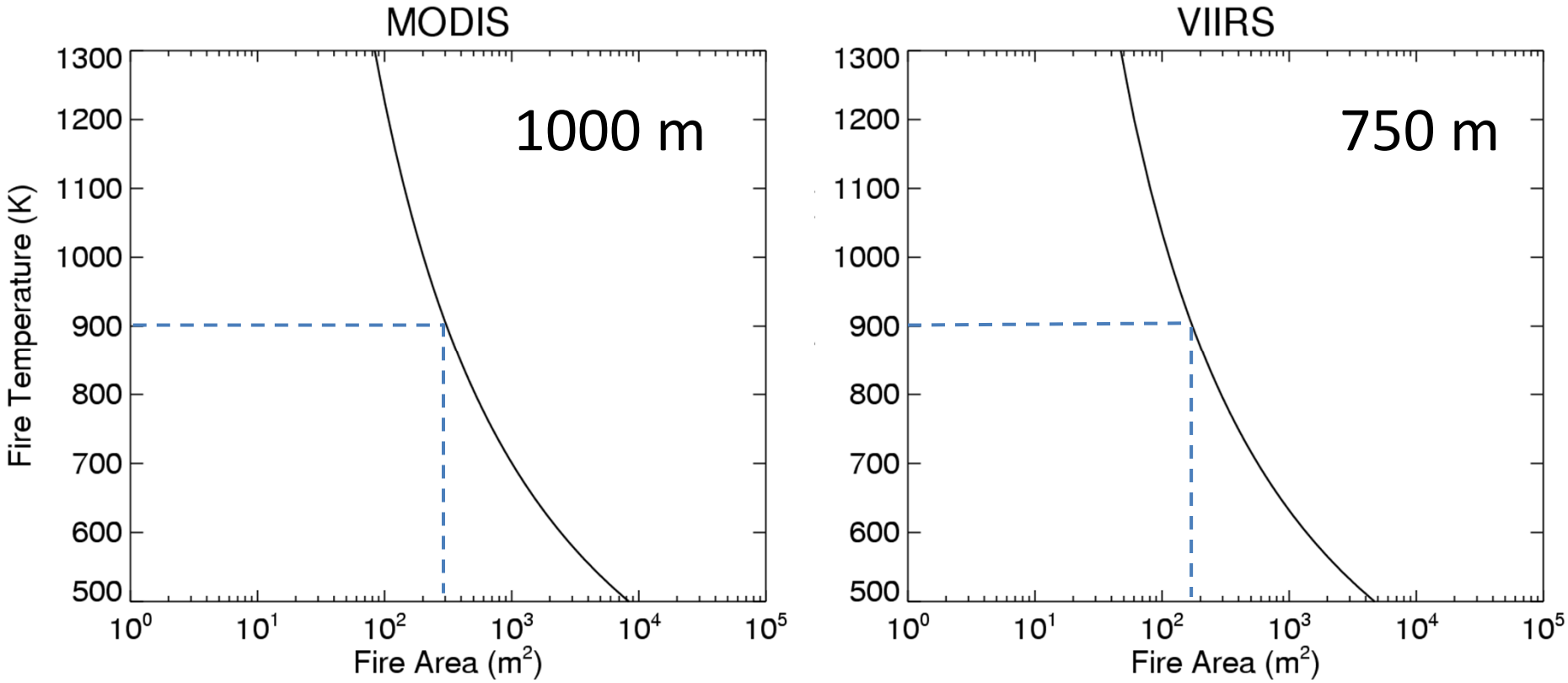
VIIRS Detector Aggregation Scheme



JPSS program

MODIS and VIIRS fire detections at nadir: modeling

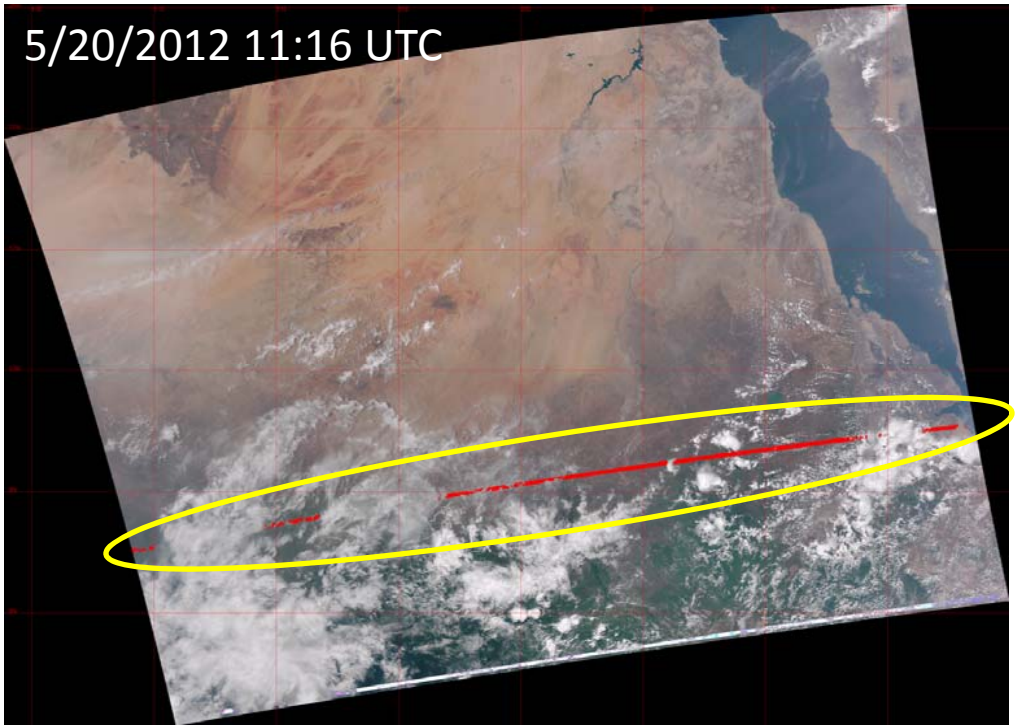
VIIRS spatial resolution is higher that of MODIS; in general,
VIIRS is expected to detect smaller fires at nadir



90% probability of detection; boreal forest; nadir view

Post-launch product evaluation

- **24/7 script for data visualization**
  - ***Designed for qualitative assessment of fire data***
  - ***Used to identify major anomalies in data***
- **VIIRS x Aqua/MODIS intercomparison**
  - ***Designed for qualitative assessment of VIIRS fire detection using near-coincident Aqua/MODIS data***
  - ***Verify active fire product consistency on a per-pixel and/or grid basis***
- **Detailed data inspection tool**
  - ***Used to assess quality of individual bands and the corresponding quality flags***
- **Collection and analysis of in-situ and airborne data**
  - ***Explicit validation***
- **M13 SDR feedback**
  - ***Aggregation, low/high gain***
- **Product improvements**
  - ***Spatially explicit fire mask***
  - ***FRP***
  - ***VIIRS-specific algorithm changes***



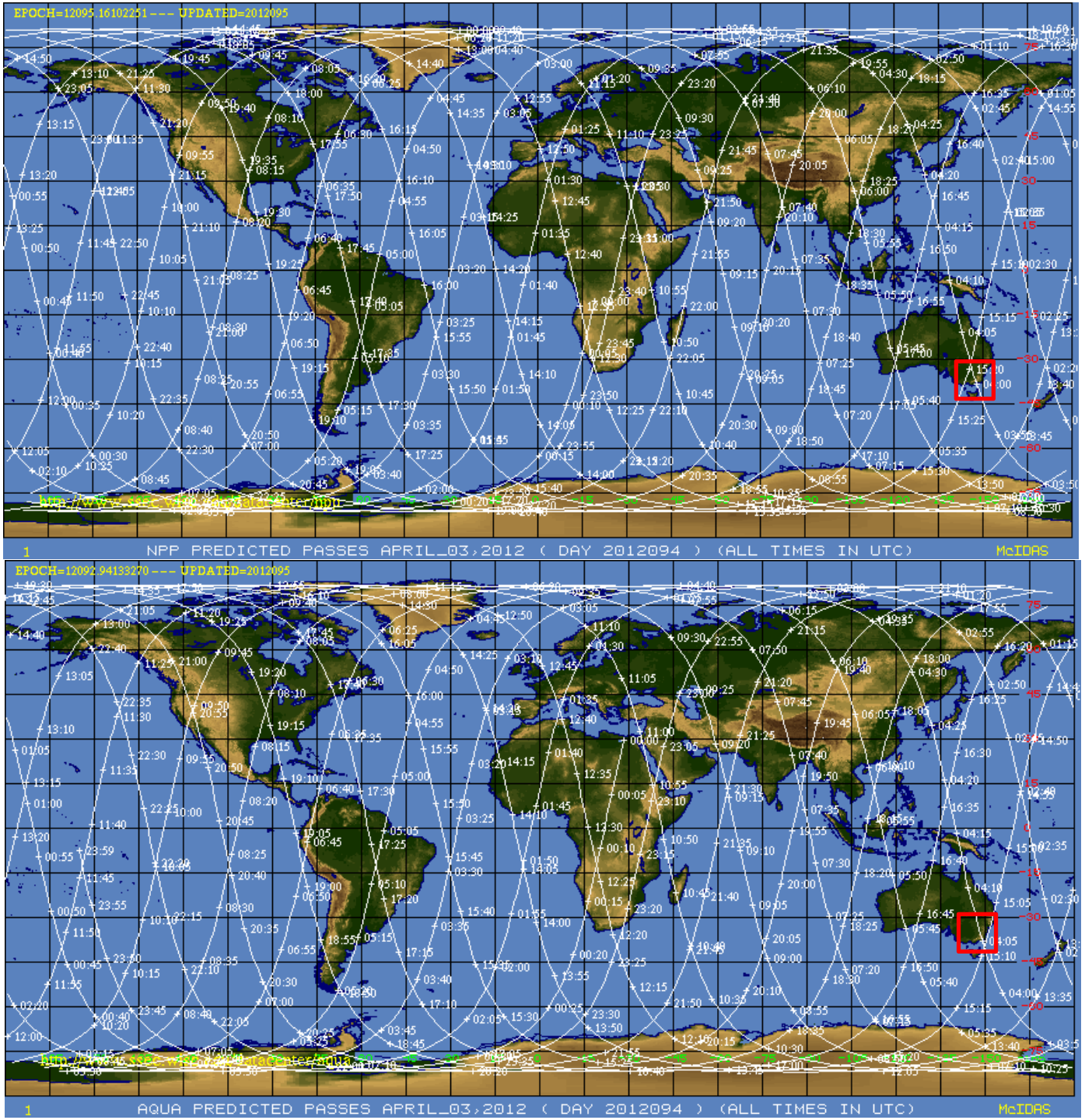
VIIRS MODIS Comparison

NPP

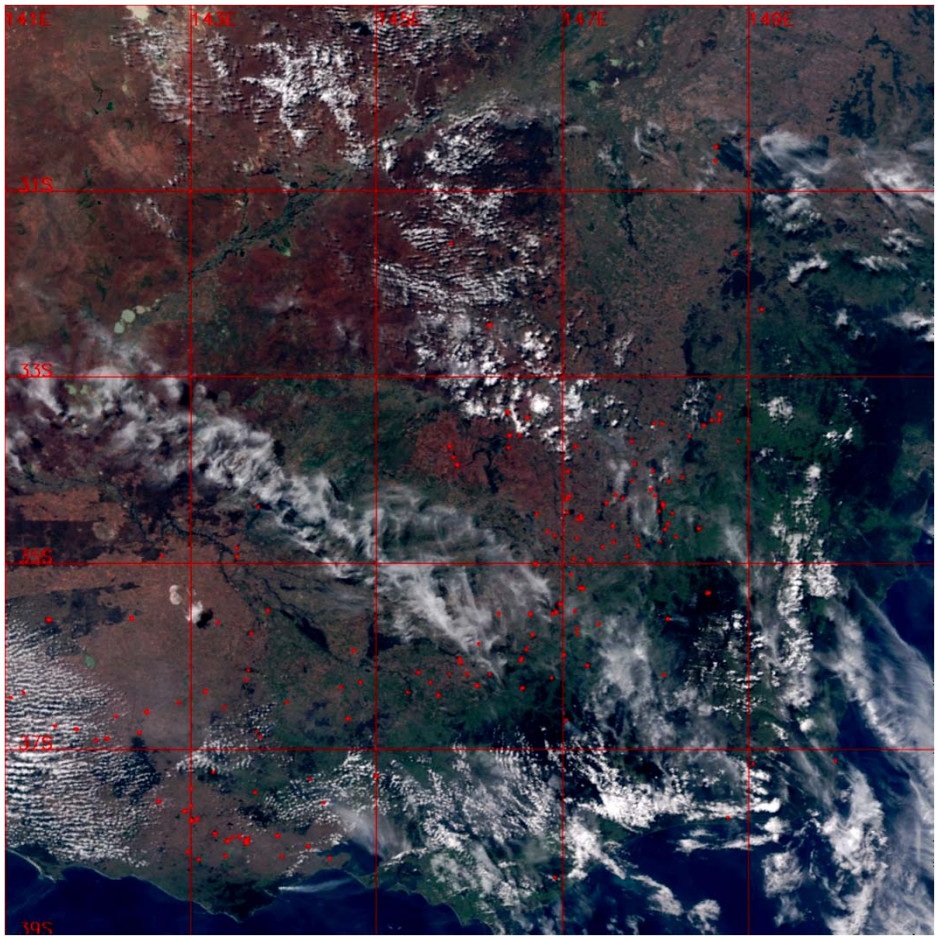
Satellite orbit tracks

April 3, 2012

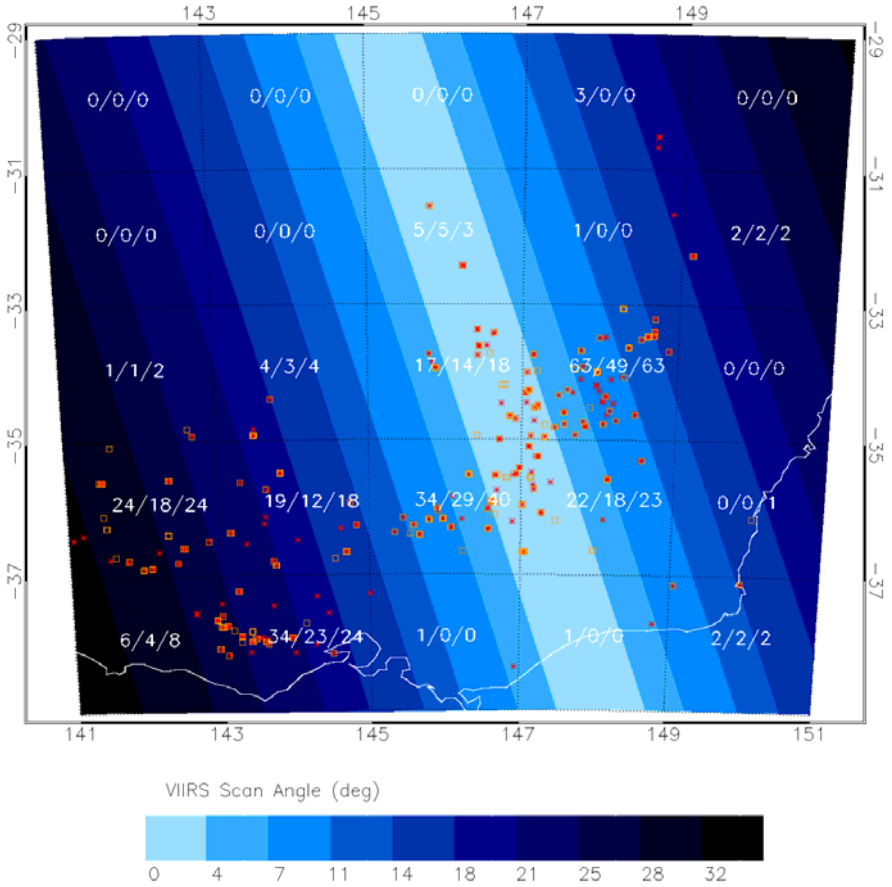
Aqua



MODIS and VIIRS fire detections at nadir: post-launch on-orbit data

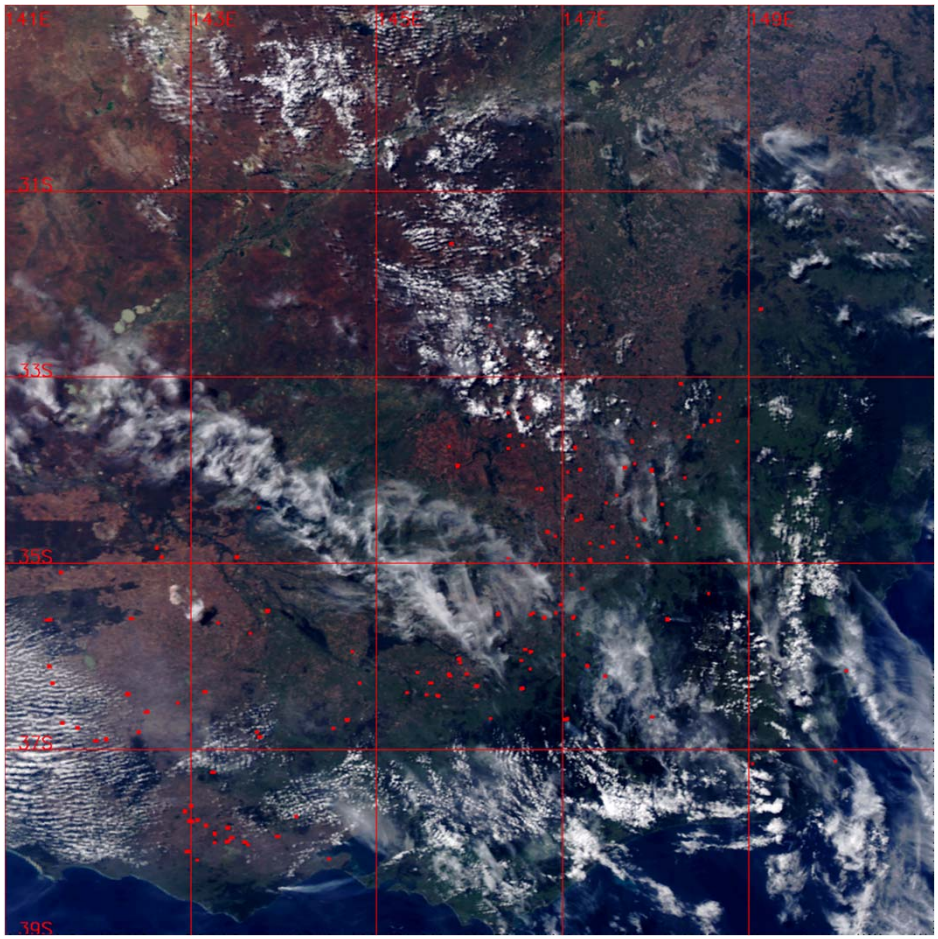


VIIRS 03 April 2012 03:55UTC
(SE Australia)

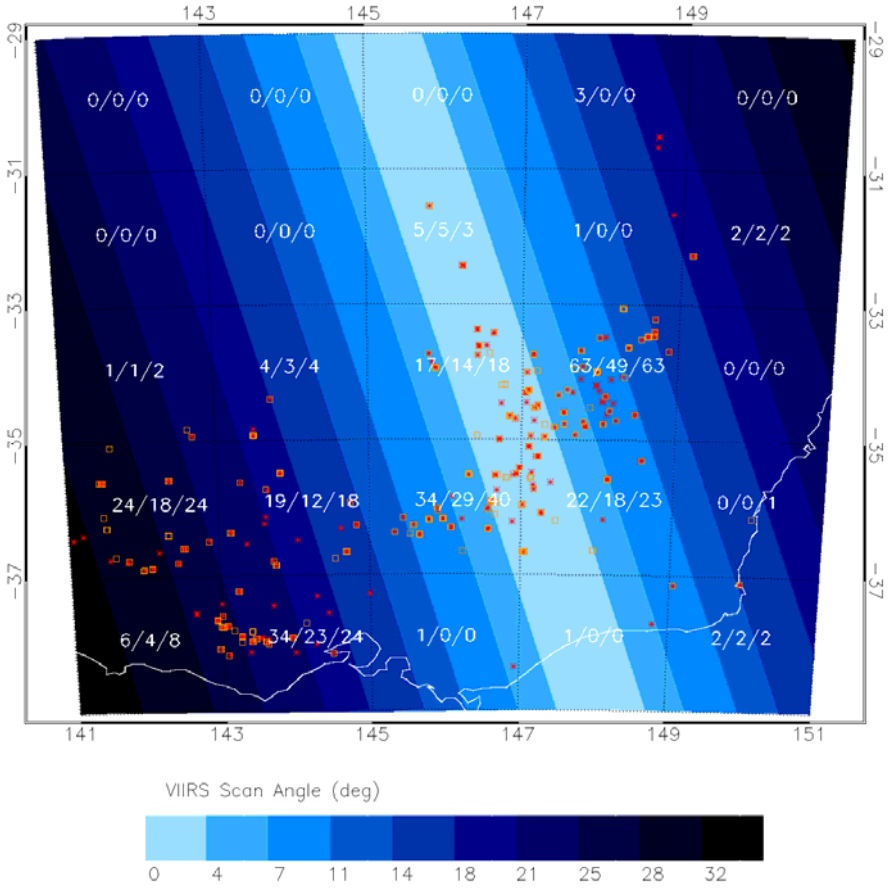


Gridded statistics: AA/BB/CC
AA – number of VIIRS fire pixels (red symbols)
BB – number of VIIRS fire pixels with overlapping Aqua/MODIS fire pixels
CC – number of Aqua/MODIS fire pixels (orange symbols)

MODIS and VIIRS fire detections at nadir: post-launch on-orbit data



MODIS 03 April 2012 04:05UTC
(SE Australia)



Gridded statistics: AA/BB/CC
AA – number of VIIRS fire pixels (red symbols)
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VIIRS MODIS Comparison

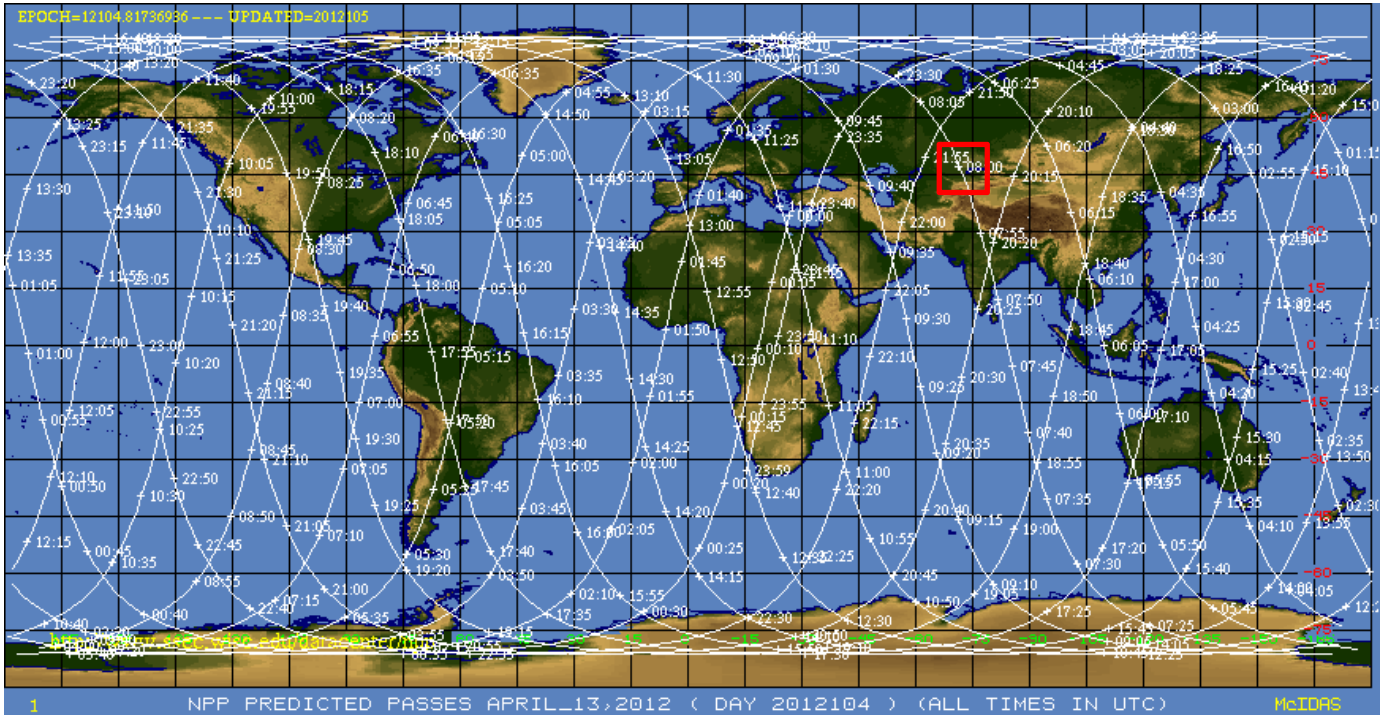
NPP

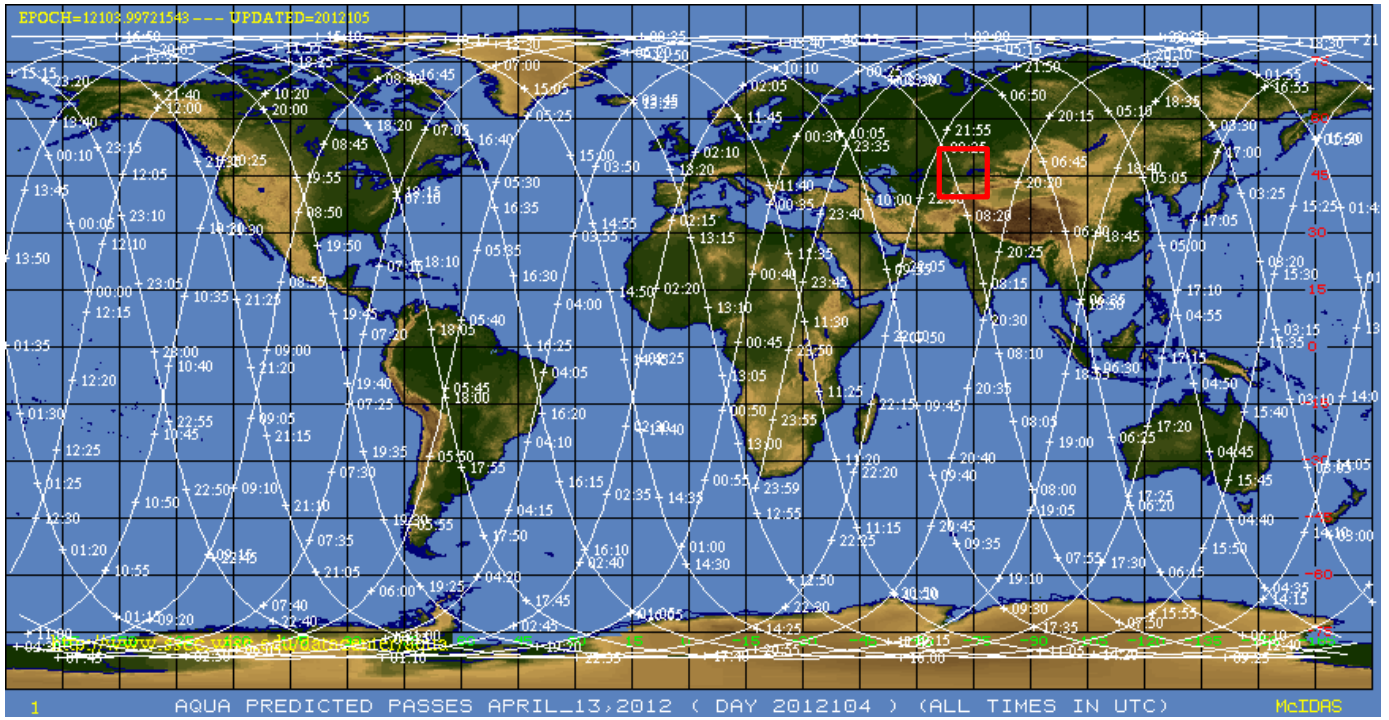
Satellite orbit tracks

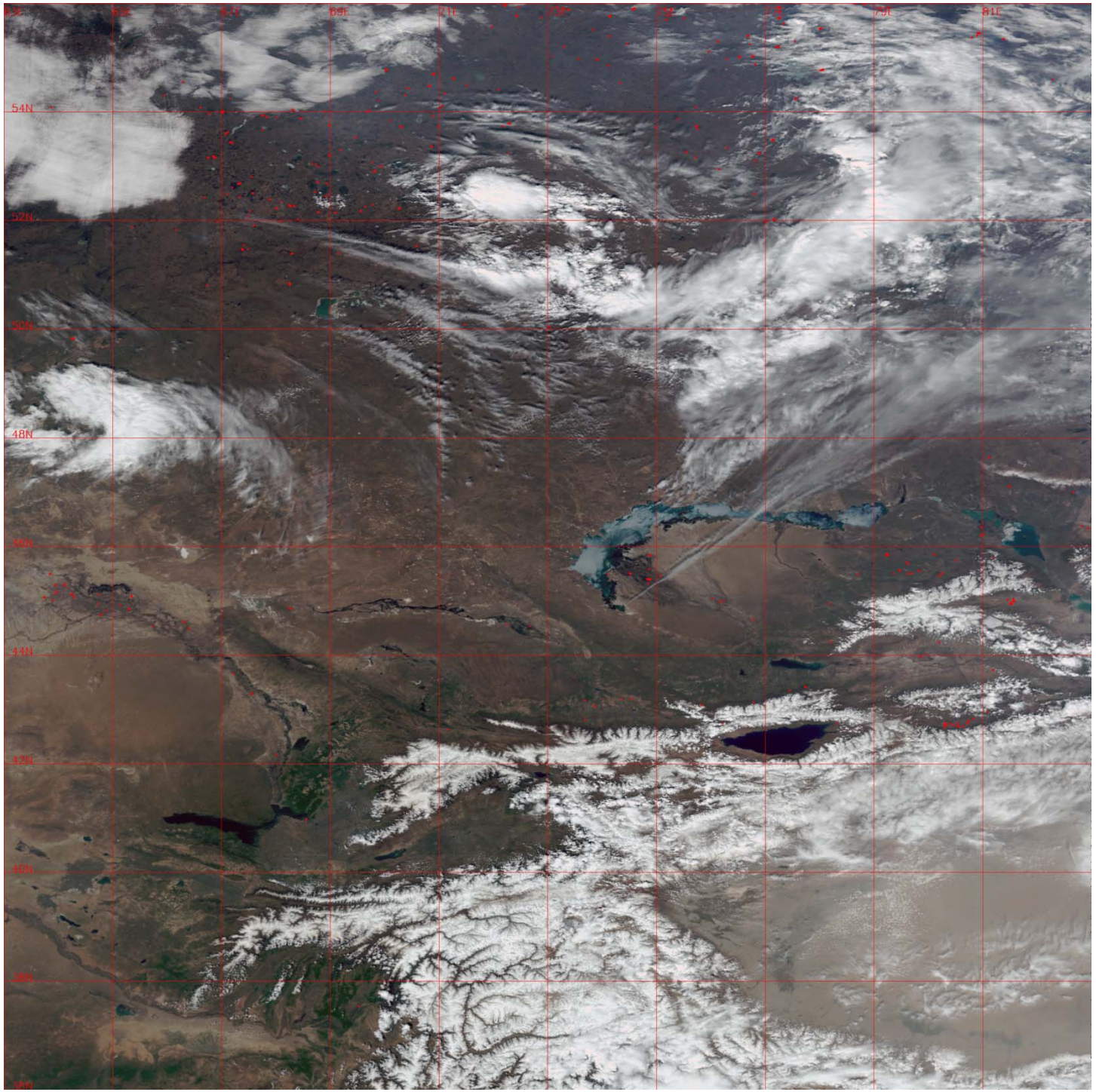
April 13, 2012

Aqua

http://www.ssec.wisc.edu/datacenter/orbit_tracks.html







NPP VIIRS

Central Asia

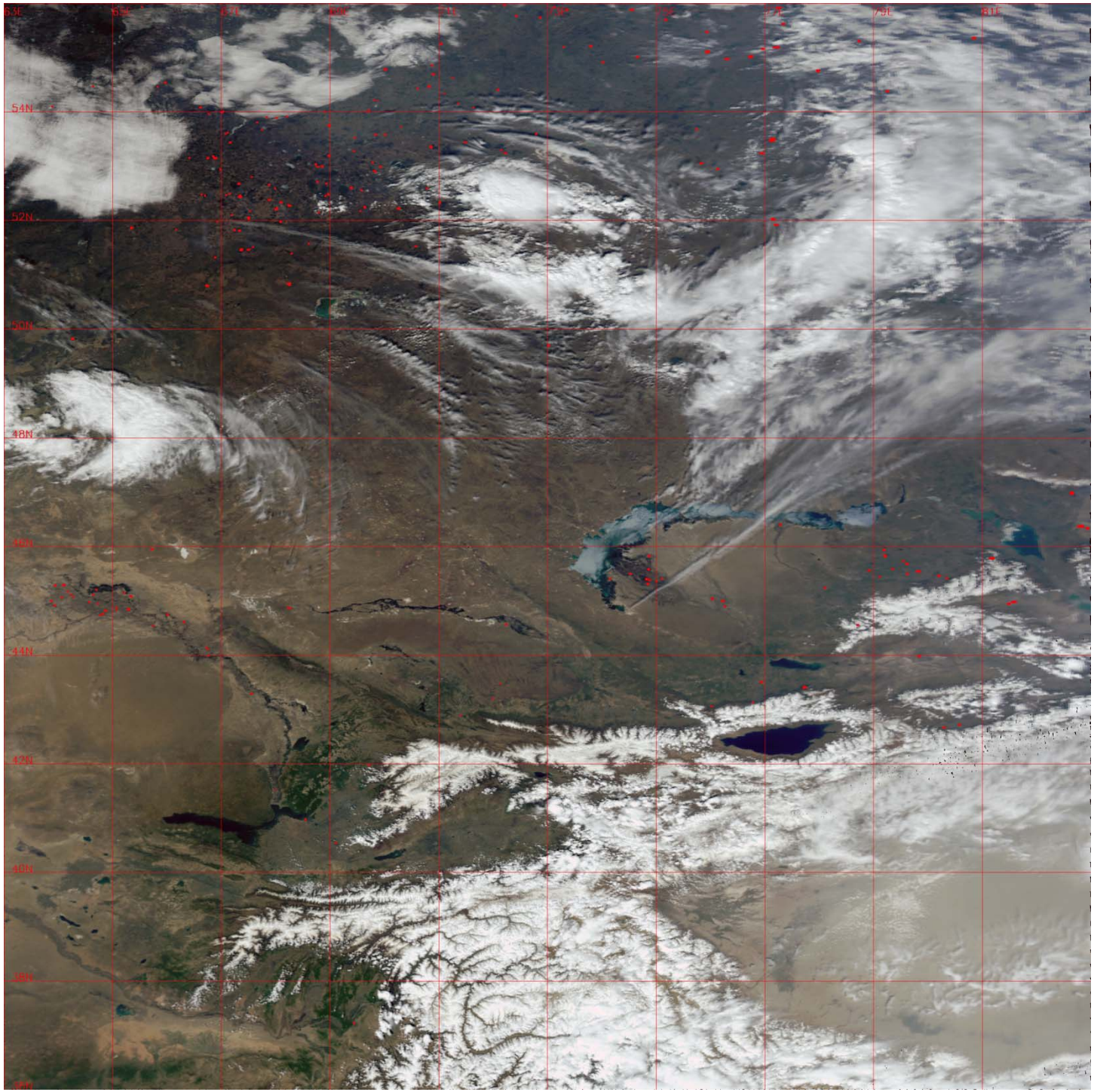
April 13 2012

7:53 UTC

M5-M4-M3 RGB

+

IDPS Active Fire ARP



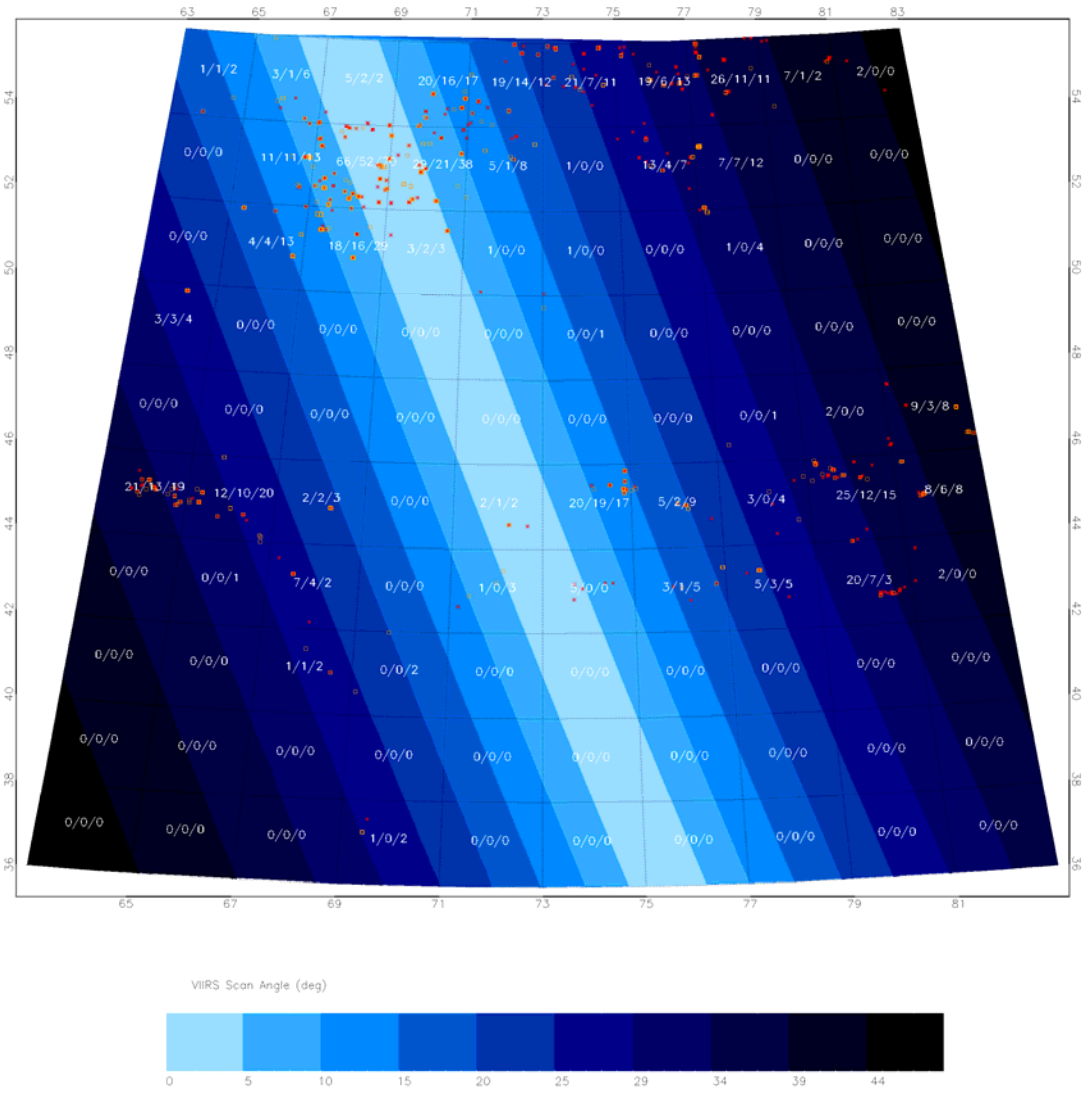
Aqua MODIS

Central Asia

April 13 2012

8:18 UTC

Band 1-4-3 RGB
+
MYD14



VIIRS/overlap/MODIS

VIIRS

vs.

MODIS

Central Asia

April 13 2012

Gridded statistics: AA/BB/CC
AA – number of VIIRS fire pixels (red symbols)
BB – number of VIIRS fire pixels with overlapping Aqua/MODIS fire pixels
CC – number of Aqua/MODIS fire pixels (orange symbols)

Further examples are available at the **JPSS VIIRS Active Fire Product website**:
http://viirsfire.geog.umd.edu/

Fire characterization from S-NPP VIIRS

- **M13 saturation temperature: 634K**
  - very small percentage of fires to trigger saturation
  - Fire Radiative Power retrieval is possible
- **M15 saturation temperature: 363K**
  - small, but non-negligible percentage of fires triggers saturation of native resolution pixels
  - more complex characterization (i.e. smoldering ratio) may be compromised
- **Fire Radiative Power to be included in VIIRS active fire product**
  - now a requirement for J1 and beyond

VIIRS active fire product development

NOAA: "real-time NOAA operational applications"

VIIRS Fire Team

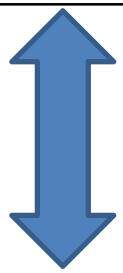
NASA: "science, long-term continuity + added value NRT"

- Operational product generated by IDPS (Interface Data Processing Segment)
- Part of integrated processing chain
- Low latency
- Detections only
- Locations only (no fire mask)

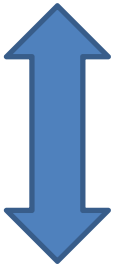
Algorithm updates

Upstream processing updates

- Experimental MODIS continuity product a at the Land PEATE (Product Evaluation and Test Element)
- Detections, Fire Mask and Fire Radiative Power, CMG
- Spatially explicit fire mask
- Spatial and temporal aggregates – heritage deliver systems (RR, FIRMS)



algorithm synchronization, end user feedback

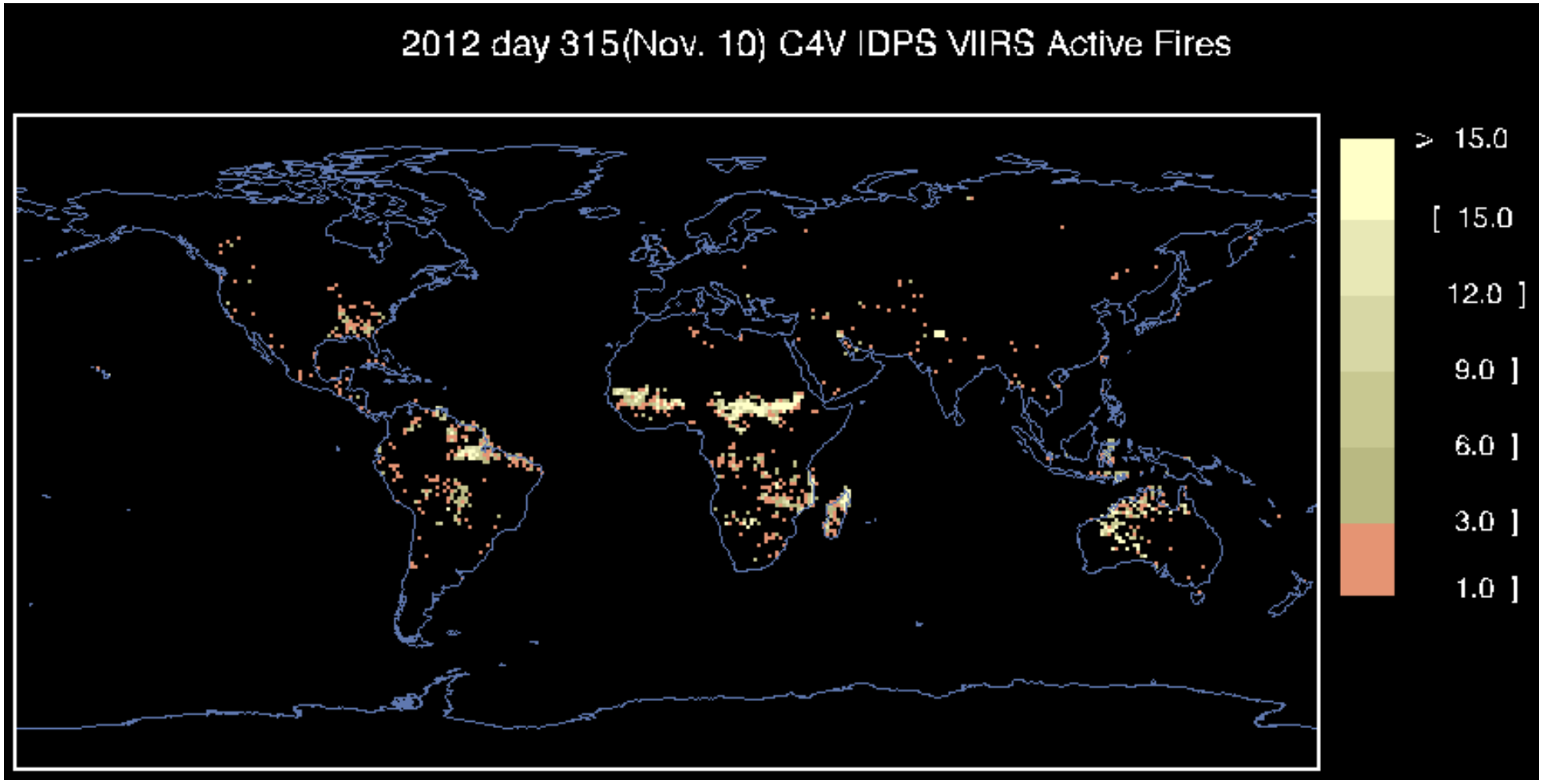


DIRECT READOUT

- **Can run IDPS, NASA or locally developed code**
- **Stand-alone**

IDPS algorithm (MODIS C4)

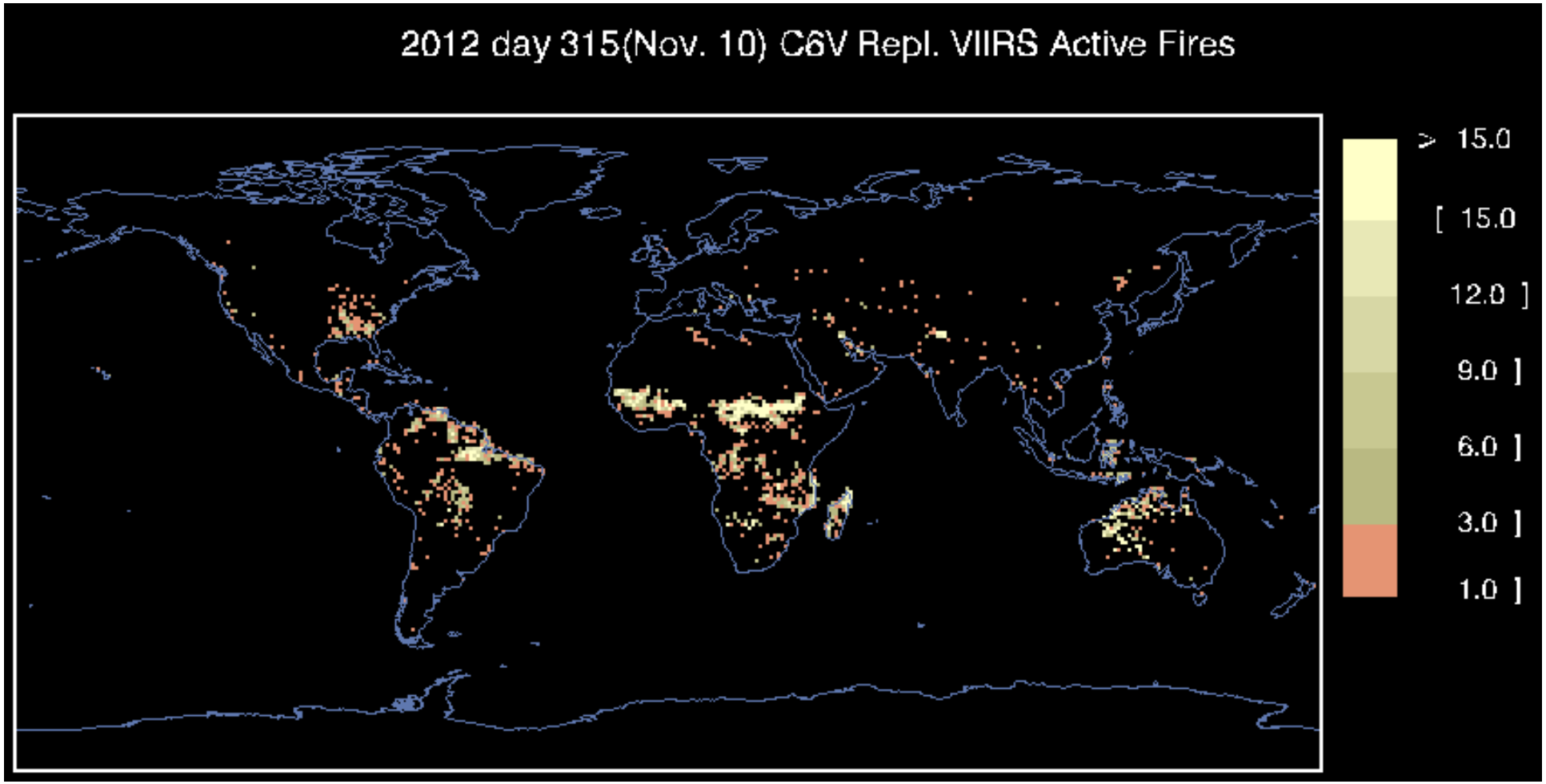
MODIS Version 4 algorithm running on VIIRS data



- ***Sparse array of fire pixels – no spatially explicit fire mask***
- ***No FRP***
- ***Land-only processing***

Replacement algorithm (MODIS C6)

MODIS V6 code running on VIIRS data at LCF and in LandPEATE

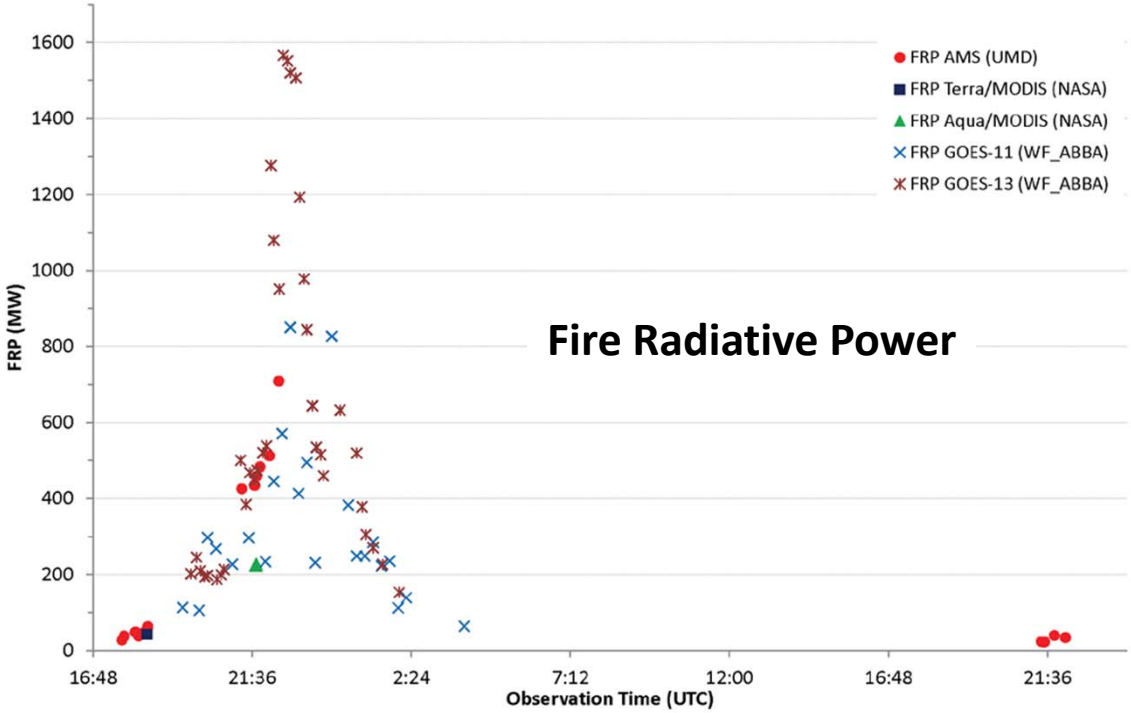


- ***Spatially explicit fire mask and FRP - > new JPSS L1 Requirements Supplement***
- ***Additional data layers for CMG***
- ***Ocean processing for gas flares, a new false-alarm rejection test over tropical regions, and dynamic potential fire thresholds***

VIIRS Fire Validation: remote sensing data

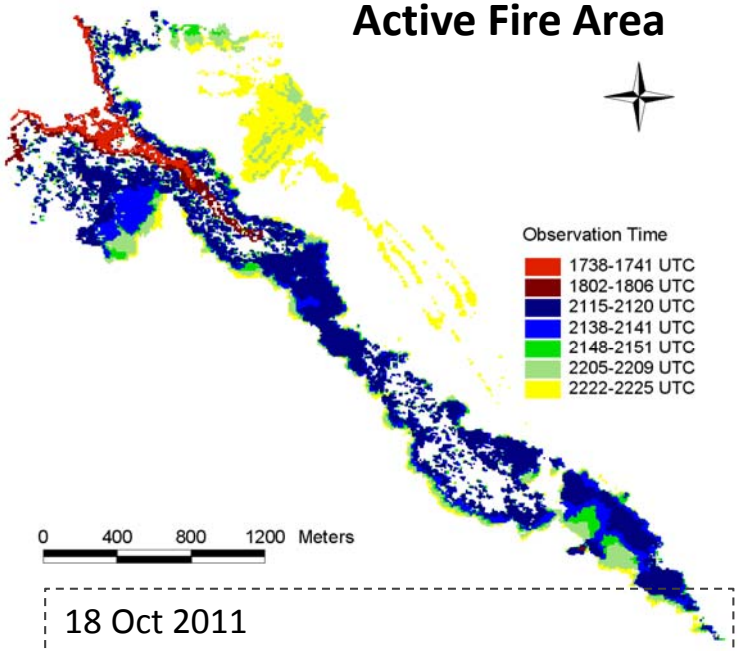
Airborne

•USDA Forest Service, NASA



Fire Radiative Power

Active Fire Area



18 Oct 2011
450 ha Rx fire at Henry Coe State Park/CA

Aerial coverage provided by NASA/Ames AMS airborne sensor @10 m resolution

Coincident acquisition from MODIS (Terra and Aqua) and GOES East/West

Spaceborne

•DLR: Technology Experimental Probe (TET-1) and Berlin Infrared Optical System (BIROS)

•Use I-band to validate M-band

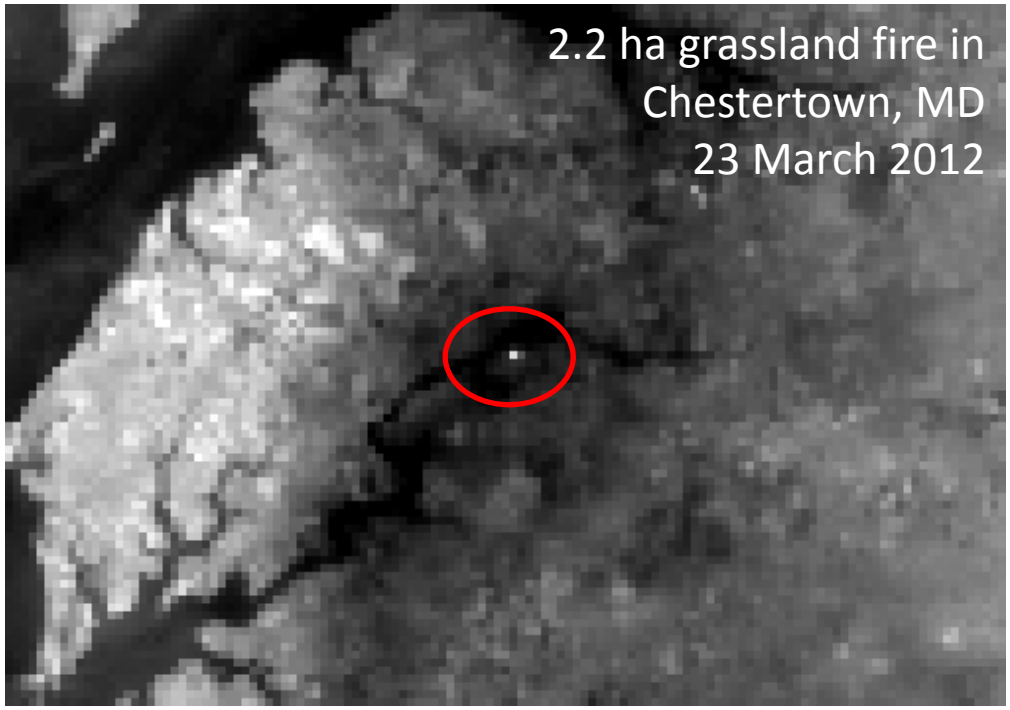
VIIRS Fire Validation: in-situ data

Ground Verification – qualitative assessment

Use of coincident prescribed burns to verify active fire detection data using both I and M bands

Engaging:

- Individuals (private land owners)
- State agencies (fire/forestry departments)
- Federal agencies (USDA Forest Service)
- International community



Validation Activities: in-situ data

Ground Verification – qualitative assessment

Use of coincident prescribed burns to verify active fire detection data using both I and M bands

Fire information provided by USDA personnel

- Date and location of burn
- Area burned
- Fuel load & fuel consumption

National Forests in Alabama

2012 Rx Fire Smoke Monitoring

Notification to NOAA NESDIS Satellite Analysis Branch

The following information should be forwarded to the NOAA NESDIS team on each burn the morning of the burn:

Date of Burn: 3/27/2012

Name of Burn: Rattlesnake

Coordinates: 33°30'59" Lat -85°43'07" Lon (decimal degrees)

Burn Acres: 500

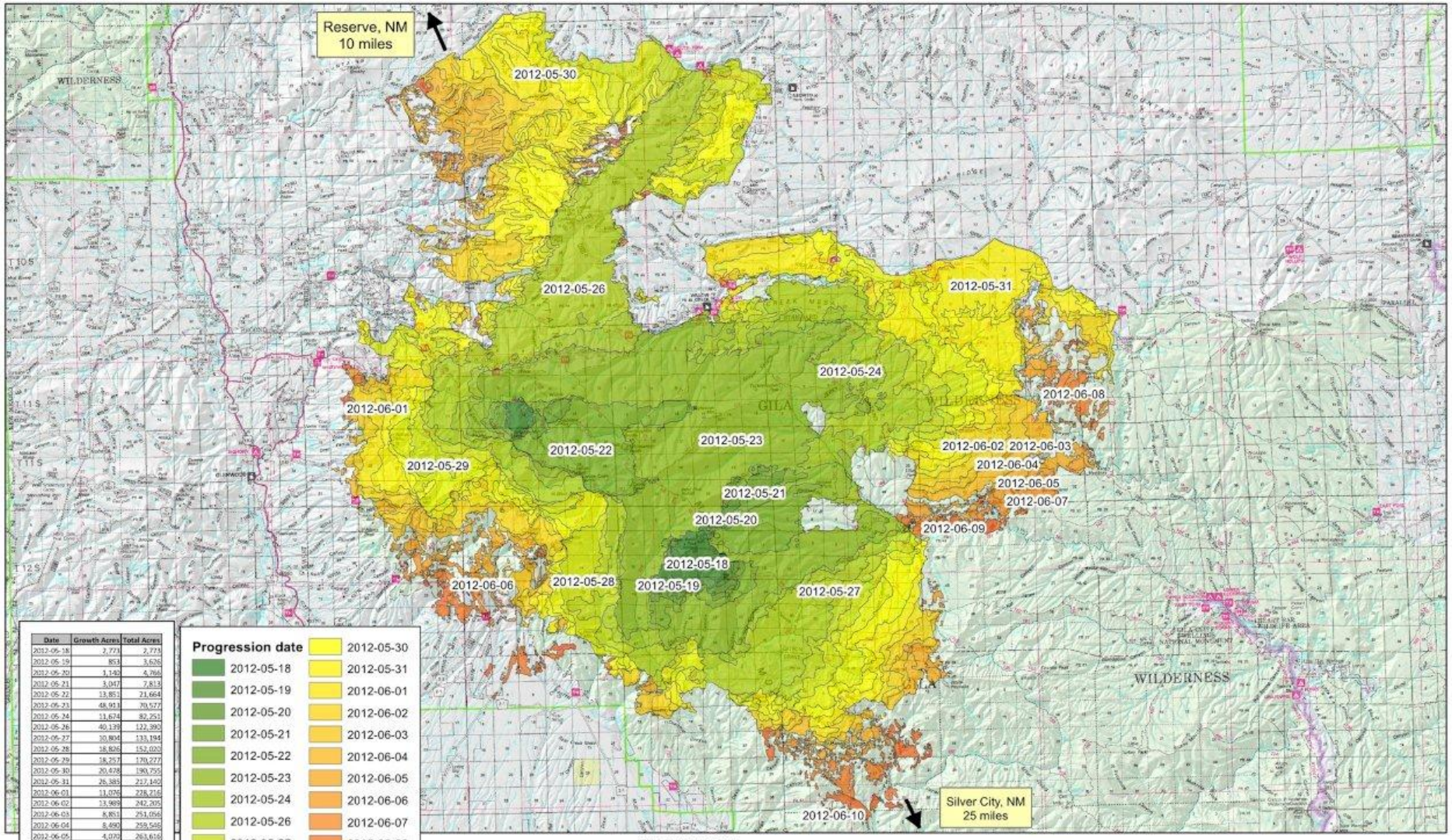
Hours of Active Burning: Start Time - 1000 (CST)

End Time: 1800 (CST)

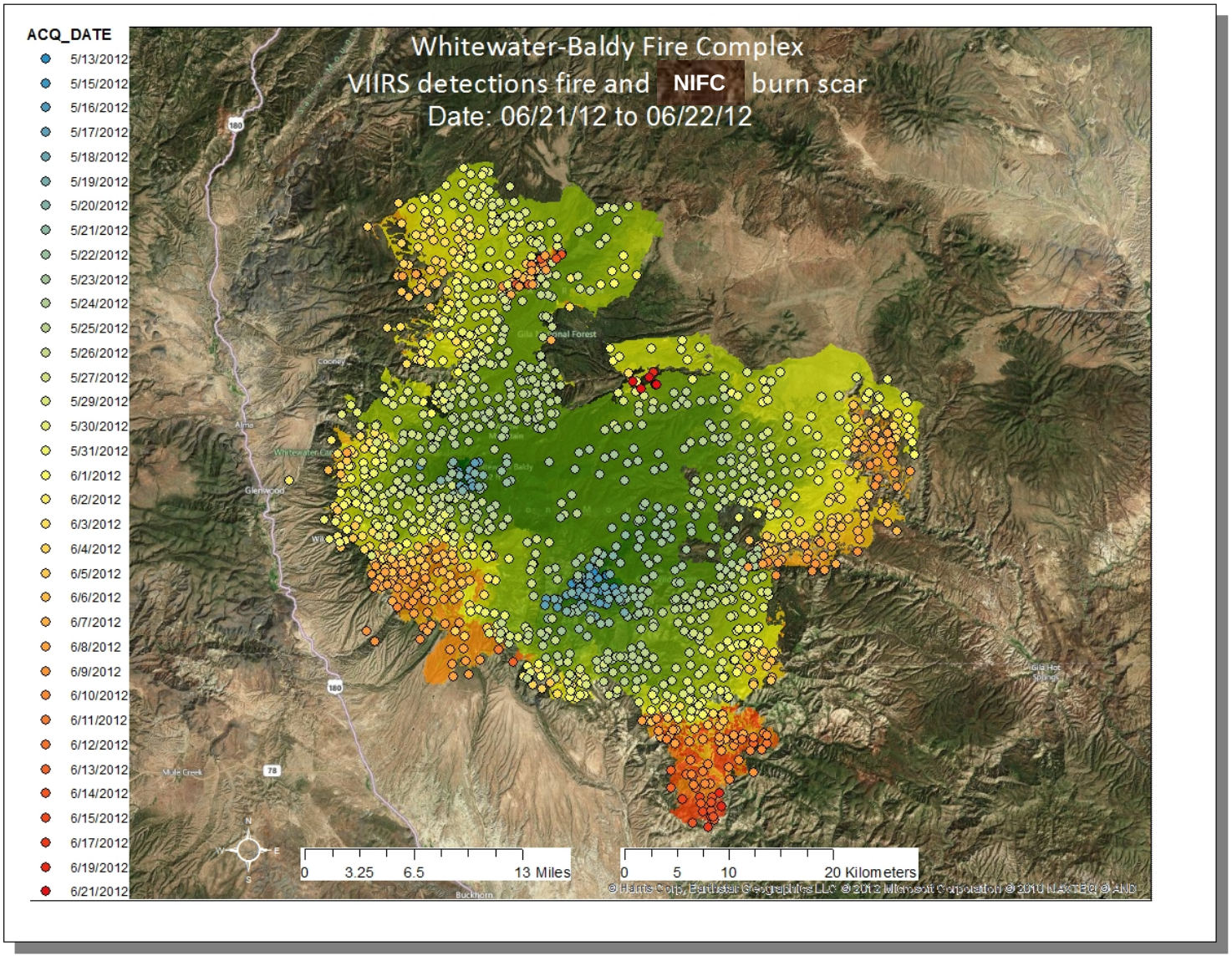
Fuel Loading: 7.0 (tons per acre)

Estimated Fuel Consumption: 5.0 (tons per acre)

Whitewater-Baldy Fire Progression



courtesy Rob Balfour


ACQ_DATE
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6/12/2012
6/13/2012
6/14/2012
6/15/2012
6/17/2012
6/19/2012
6/21/2012
Whitewater-Baldy Fire Complex
VIIRS detections fire and NIFC burn scar
Date: 06/21/12 to 06/22/12
0 3.25 6.5 13 Miles
0 5 10 20 Kilometers

VIIRS fire data access

- Options:
  - NOAA CLASS Web
    - www.class.noaa.gov
  - NASA LAADSWeb
    - ladsweb.nascom.nasa.gov/data/search.html
  - NOAA CLASS ftp (anonymous)
    - ftp-npp.class.ngcd.noaa.gov
  - NASA LAADS ftp (anonymous)
    - ladsweb.nascom.nasa.gov
- Detailed instructions:

  viirsfire.geog.umd.edu/Documents/VIIRS_data_tutorial.pdf

VIIRS Fire Summary and Conclusions

- **Early assessment** of the SNPP VIIRS fire product is **encouraging**
- Active Fires product has been declared **Beta maturity** and is publicly available for evaluation
- User Readiness and Proving Ground activities are reaching out various **domestic and international end users - goal is the continuity and enhancement of the MODIS product suite – LANCE, RR, FIRMS**
- Implementation of **DB processing systems** is underway domestically and internationally
  - Continuing coordination regarding product evaluation and algorithm versioning is critical
- More work is needed to implement **new MODIS algorithm components** (C6) and **sensor-specific tuning** in the VIIRS product, product content and product suite
  - Use of **I band - DNB data** (detection, validation, fused products)
- **Validation** of global product remains crucial and will be challenging

VIIRS Active Fire Product Website

viirsfire.geog.umd.edu

Fire Observations from New Instruments

Louis Giglio (University of Maryland) and
many others

GOFC-Gold Land Monitoring Symposium

15-19 April 2013, Wageningen, Netherlands

This presentation – can be found on the GOFC GOLD Fire Web Site

http://gofc-fire.umd.edu/meeting/static/Netherlands_2013/index.php

Major New and Future Polar Orbiting Satellite Systems

Satellite / Sensor	Resolution	Bands
~~SAC-D NIRST (2011)*~~	~~~390 m~~	~~MIR, TIR~~
Suomi-NPP VIIRS (2011)*	375 m, 750 m	VIS, NIR, SWIR, MIR, LWIR
TET-1 (2012)*	42 m, 370 m	SW, NIR, MIR, LWIR
LDCM (2013)*	15, 30, 100 m	VIS, NIR, SWIR, LWIR
GMES Sentinel-3 SLST (2014)	500 m - 1 km	VIS, NIR, SWIR, MIR, LWIR
GMES Sentinel-2 MSI (2014)	15, 20, 60 m	VIS, NIR, SWIR
GCOM-C1 SGLI (2014)	250 m, 500 m, 1 km	VIS, NIR, SWIR, LWIR
JPSS VIIRS (2016-)	375 m, 750 m	VIS, NIR, SWIR, MIR, LWIR
HyspIRI (2019)	60 m	VIS - SWIR, MIR, LWIR
Geo-Africa (2014?)	25 m	?, MIR, LWIR

**Recently launched or operational.*

Major New and Future Geostationary Satellite Systems

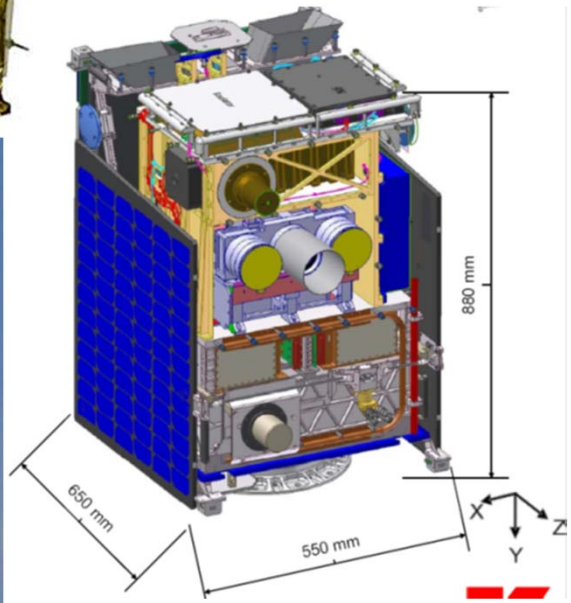
Satellite / Sensor	Resolution	Bands
India INSAT-3D (2013/2014)	1 – 4 km	VIS, SWIR, MIR, LWIR
JMA Himawari-8 AHI (2014)	500 m – 2 km	VIS, NIR, MIR, LWIR
GOES-R ABI (2015)	500 m – 2 km	VIS, NIR, SWIR, MIR, LWIR
CMA FY-4A AGRI (2015)	500 m – 4 km	VIS, NIR, MIR, LWIR
MTG-I1 FCI (> 2018)	500 m – 2 km	VIS, NIR, MIR, LWIR
GEO-KOMPSAT-2A AMI (> 2017)	500 m – 2 km	VIS, NIR, MIR, LWIR
Russia Elektro-M MSU-GSM (2017)	500 m – 2 km	VIS, NIR, SWIR, MIR, LWIR

The current BIRD follow-up Program in Germany

The TET-1 Satellite

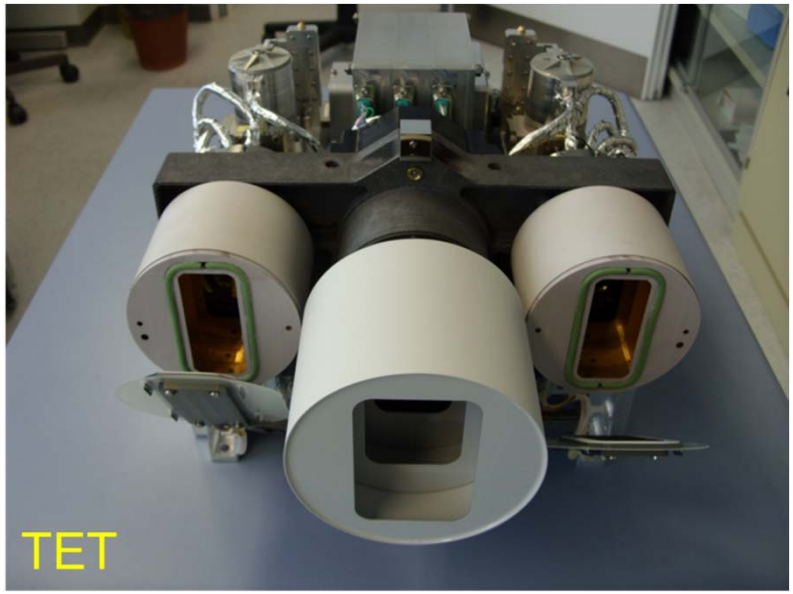
- Based on the BIRD Satellite Technology the German Space Agency initiated in 2005 the OOV Program
- The first programme part was finalised with the launch of the TET-1 Satellite on 22 July 2012

- The TET Satellite is primary dedicated to technological experiments and not to fire monitoring
- A BIRD like IR Instrument was added later
- In the first year the observation time has to be shared with other, but smaller instruments



The current BIRD follow Program in Germany

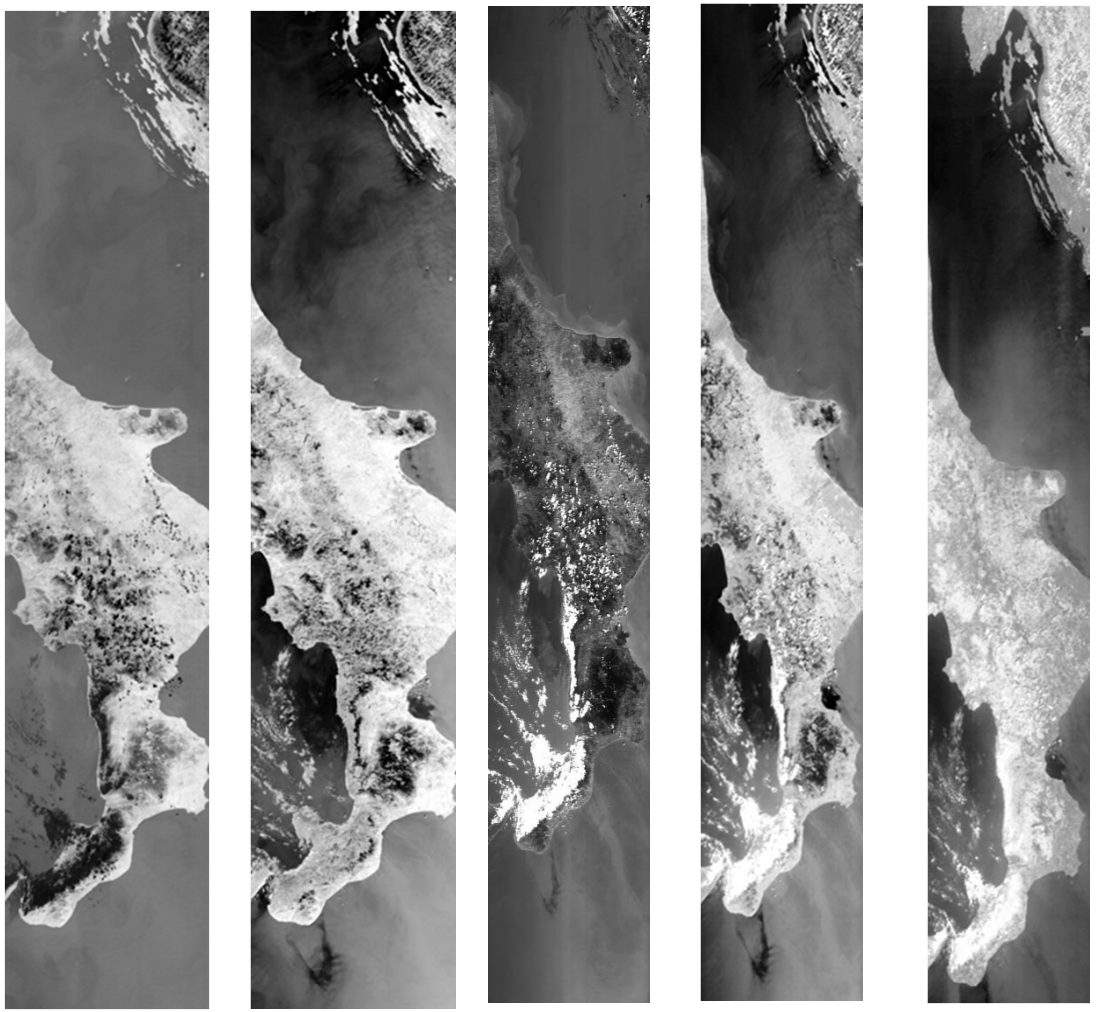
The TET-1 Satellite



- The basic Parameters for the IR instrument on TET are mainly the same as for the BIRD instrument
- Compared to BIRD a powerful on board processing will be implemented dedicated to the generation of high level fire observation data products

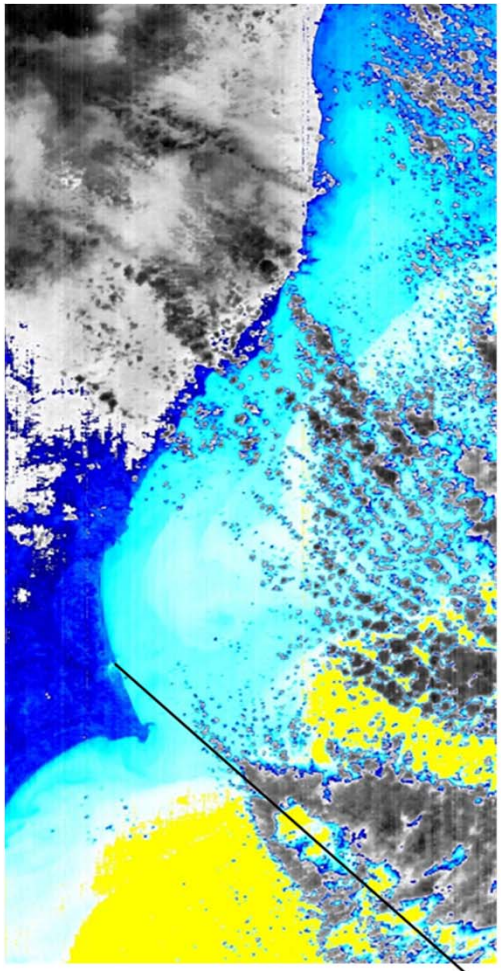
First Data Take 27. 07. 2012 over the Mediterranean Sea

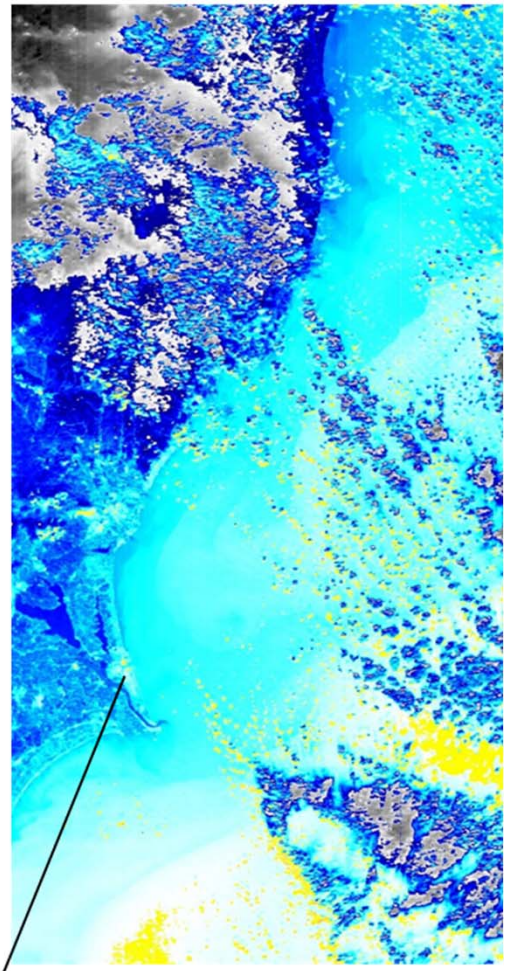
orbit trace



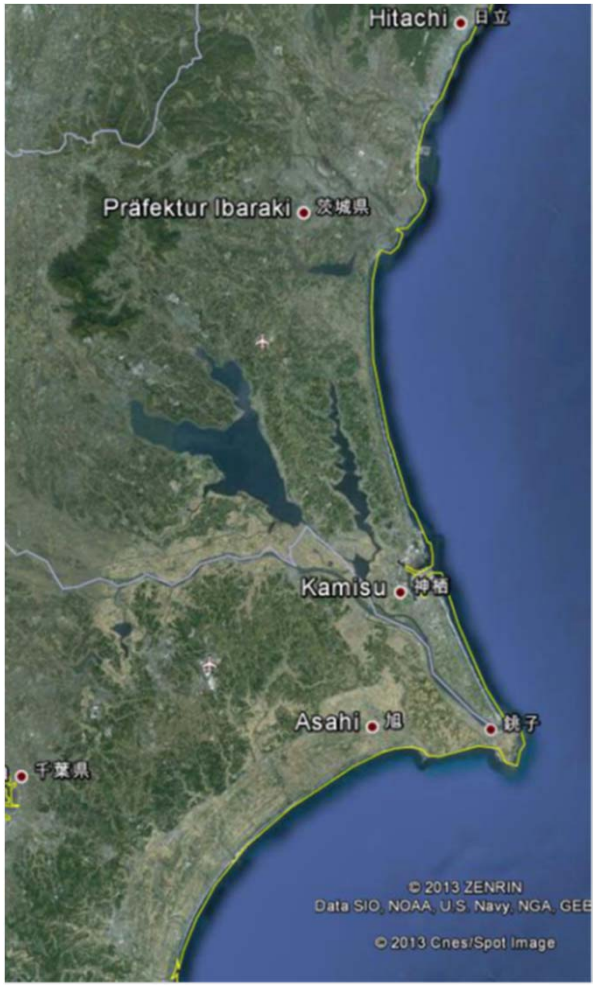
LW MW Green Red NIR

Data Take 18. 01. 2013 01:41:03 UTC Kamisu, Japan;





Industrial hot Spots of Kamisu



LDCM: Spectral Bands

L7 E	DCM OLI/TIRS Band Requirements	
	) m, Coastal/Aerosol, 0.433–0.453 µm **(*A)**	Band 1
Ban	) m, Blue, 0.450–0.515 µm	Band 2
Ban	) m, Green, 0.525–0.600 µm	Band 3
Ban	) m, Red, 0.630–0.680 µm	Band 4
Ban	) m, Near-IR, 0.845–0.885 µm	Band 5
Ban	) m, SWIR-1, 1.560–1.660 µm	Band 6
Ban	) m, SWIR-2, 2.100–2.300 µm	Band 7
Ban	5 m, Pan, 0.500–0.680 µm	Band 8
	) m, Cirrus, 1.360–1.390 µm **(*B)**	Band 9
Ban	)0 m, LWIR-1, 10.30–11.30 µm **(*C)**	Band 10
	)0 m, LWIR-2, 11.50–12.50 µm **(*C)**	Band 11

Source: NASA/USGS NP-2009-11-109-GSFC

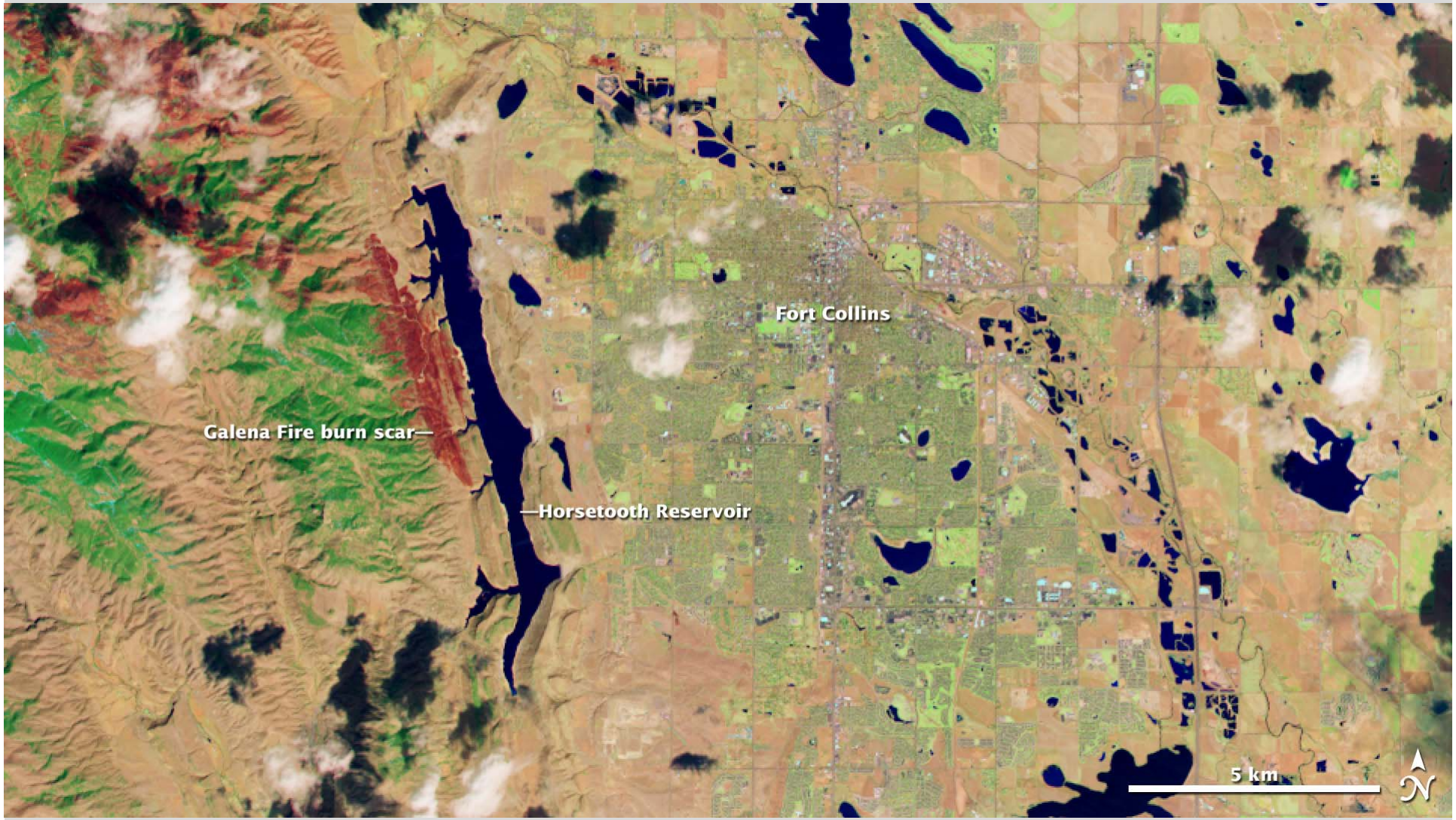
OLI First Light Image (True Color)

NASA

Wyoming and Colorado, USA

18 March 2013

OLI First Light Image (False Color SWIR/NIR/green)

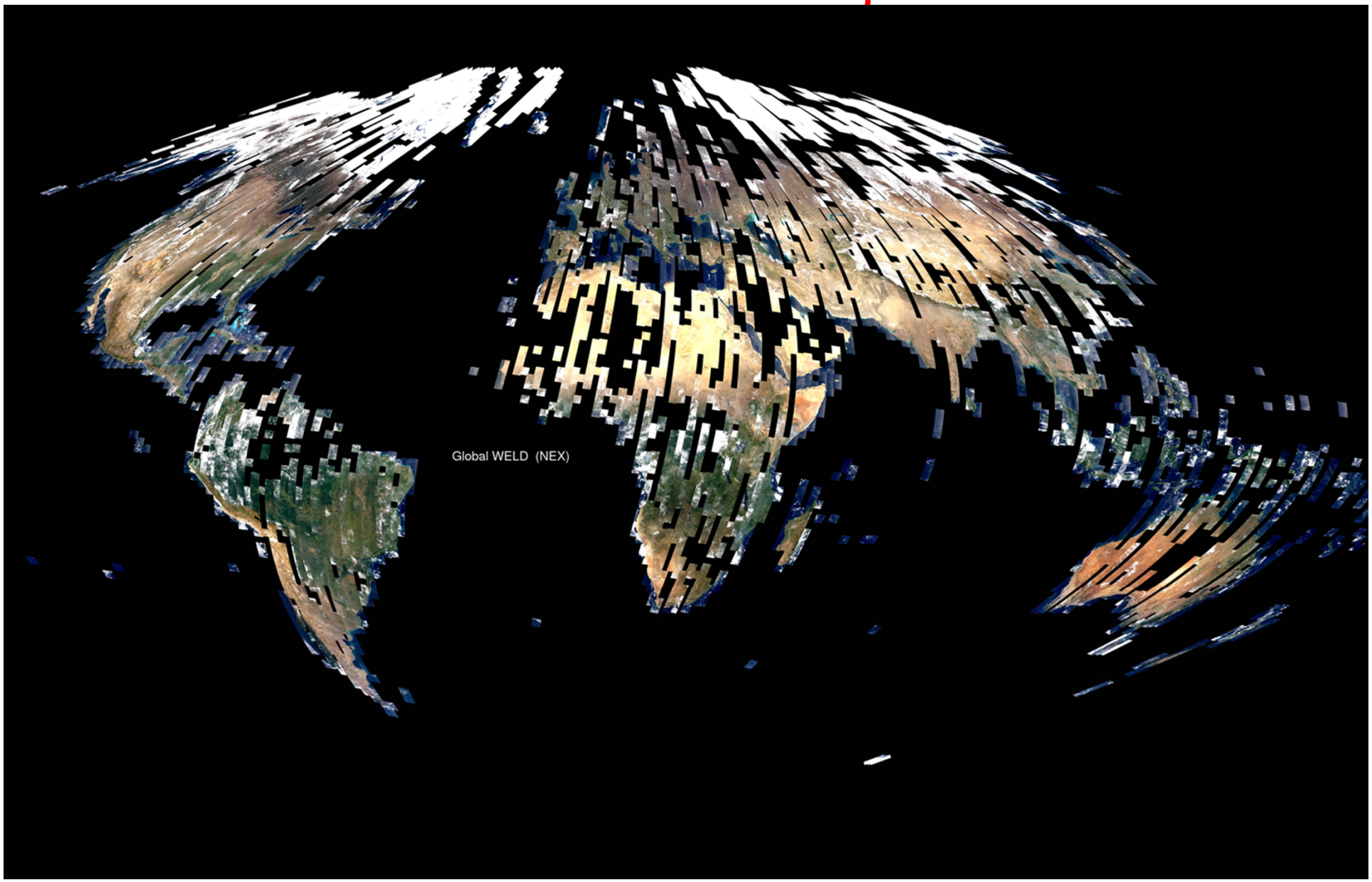


NASA

Wyoming and Colorado, USA

18 March 2013

NEX – Global WELD April 2010

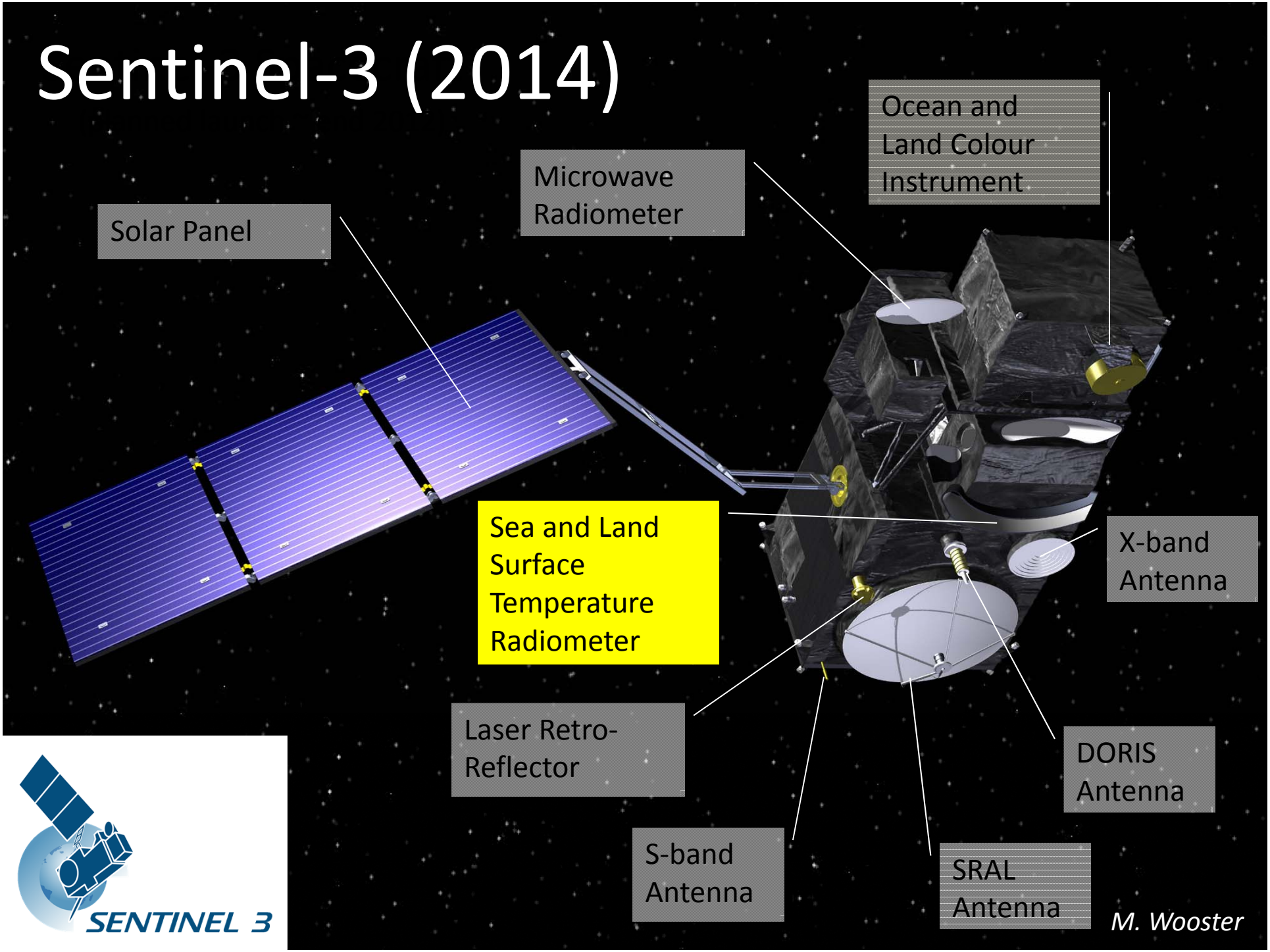


1.8km TOA true color browse, each browse pixel generated from 60 x 60 30m WELD pixels, sinusoidal projection

ESA Sentinel-2 MSI

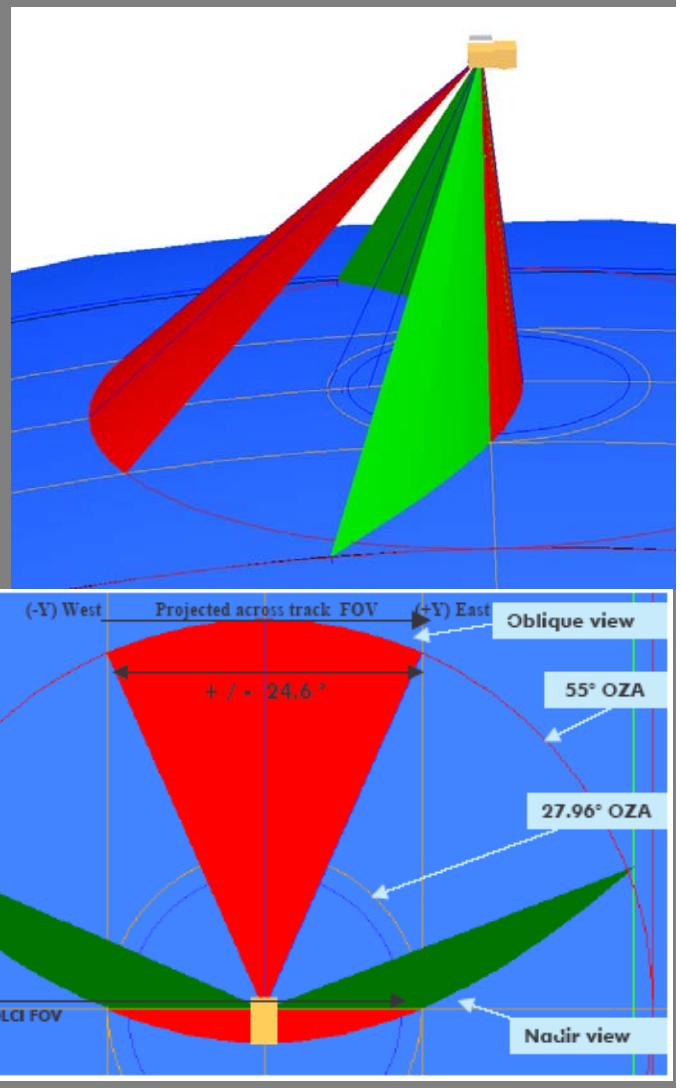
- Multi Spectral Instrument (MSI)
- Designed for continuity of Landsat and SPOT-type systems
- High resolution visible – SWIR bands
  - 10 m, 20 m, 60 m
- 290 km swath
- 2014 launch
- 5-day revisit time with **two satellites** operating concurrently
- Fuel mapping, burned area mapping, active fire detection using SWIR bands (?)

Sentinel-3 (2014)



SLSTR Overview

- Heritage from AATSR, dual-view (nadir and backard) required for aerosol corrections:
  - Nadir swath >74˚ (1300 km min up to 1800 km)
  - Dual view swath 49˚ 750 km
  - Nadir swath covering OLCI
- 9 spectral bands:
  - Visible : 555 – 659 - 859 nm
  - SWIR : 1.38 – 1.61 – 2.25 µm
  - TIR : 3.74 – 10.85 – 12 µm
- One Vis/IR channel used for co-registration with OLCI



O. Arino, ESA

Sentinel-3 SLSTR Details

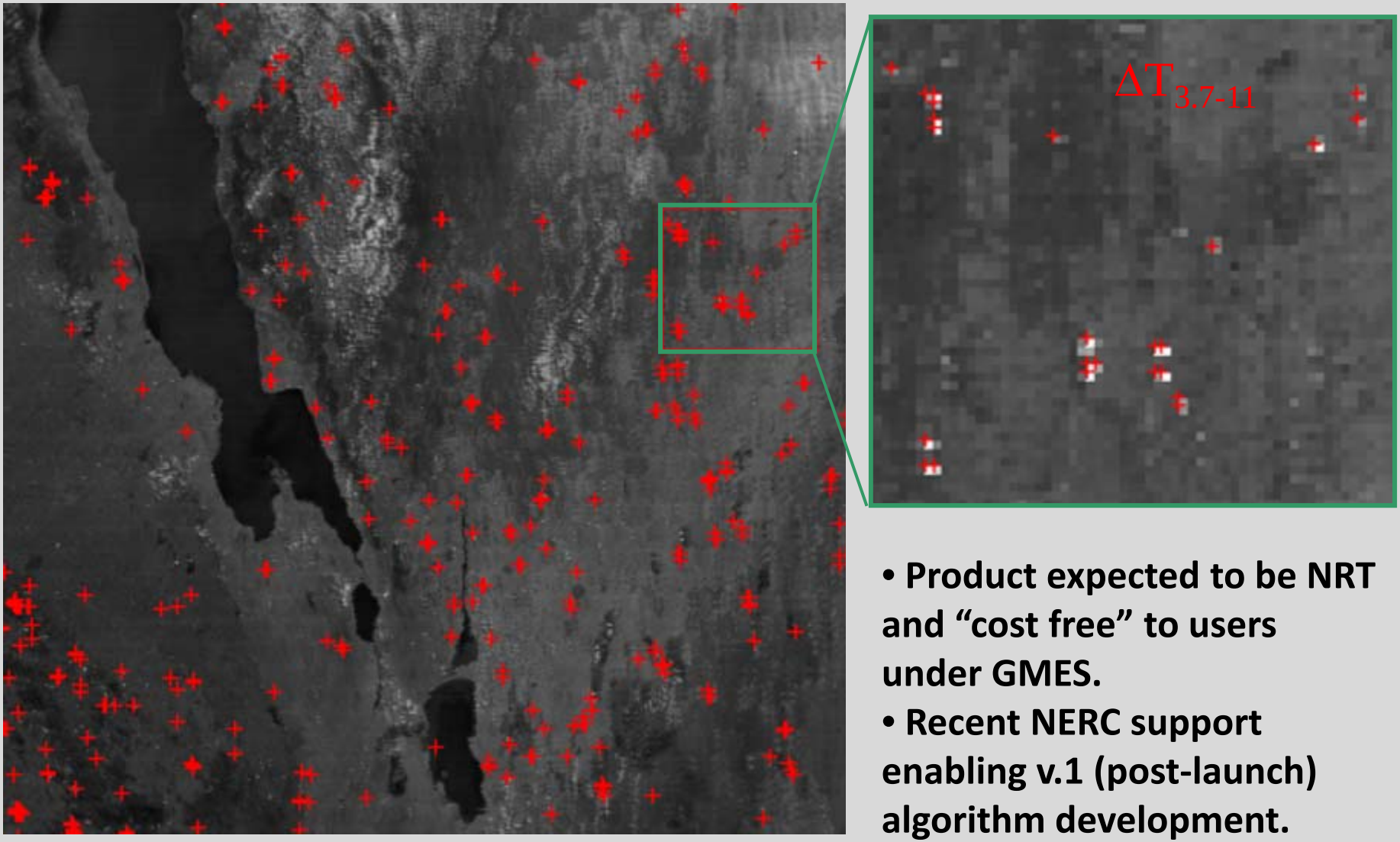
Band #	Centre λ_{centre} µm	Spectral Width $\Delta\lambda$ µm	Ref SSD
S1	0.555	0.02	0.5km
S2	0.659	0.02	0.5km
S3	0.865	0.02	0.5km
S4	1.375	0.15	0.5km
S5	1.61	0.06	0.5km
S6	2.25	0.05	0.5km
S7	3.74	0.38	1km
S8	10.85	0.9	1km
S9	12.0	1.0	1km
F1	3.74	0.38	1km
F2	10.85	0.9	1km

- SLSTR takes two views of Earth location within a few minutes (similar AATSR)
- Expanded Swaths@ ~1675 km (nadir view) + ~750 km (forward view)
- Extended dynamic range "fire channels" (F1 & F2)

- Two sun-synchronous Sentinel-3 satellites, local solar time ~ 10:00am
- Two satellites to obtain ~0.5 day revisit time.

M. Wooster

SLSTR Algorithm Prototyping & Testing (tested with MODIS MOD21data)



Multiple low FRP fires in Africa (Lake Malawi)

- **Product expected to be NRT and "cost free" to users under GMES.**
- **Recent NERC support enabling v.1 (post-launch) algorithm development.**

M. Wooster

JAXA GCOM Satellites

- GCOM-W1 (“SHIZUKU”)
  - Launched May 2012
  - Advanced Microwave Scanning Radiometer 2 (AMSR2)
- GCOM-C1
  - Second generation Global Imager (SGLI)
  - Launch 2014
- GCOM-W2 (2016), GCOM-C2 (2017), GCOM-W3 (2020), GCOM-C3 (2021)